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A COCKPIT NATURAL LANGUAGE STUDY -  
SELECTED TRANSCRIPTS

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WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-6553

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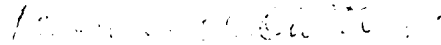
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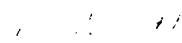


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19. ABSTRACT (Continue on reverse if necessary and identify by block number) This third report on the Cockpit Natural Language (CNL) study contains a brief description of the purpose and methodology of the CNL study, a section on lessons learned, scenario situation descriptions, a glossary and transcripts from 9 of the 54 pilots interviewed. Pilot comments cover the issues and implementation details of automation, displays, voice interaction and artificially-intelligent computer aids. Lessons learned from the CNL study include (1) Voice interaction is best employed as a new channel of information transfer, not just as a backup mode for manual or visual channels. For example, voice should be used at the intent-level (e.g., "avoid SAM" which means to re-plan route, altitude, etc. to avoid enemy surface-to-air missile detection), or to command multiple aircraft subsystems simultaneously (e.g., "target helicopter" which means to achieve a radar lock on the helicopter and select an air-to-air missile), not just to replace a single switch actuation (e.g., "select air-to-air missile"), which is done quicker manually than verbally. (over)			
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22a. NAME OF RESPONSIBLE INDIVIDUAL Captain Ronald L. Small		22b. TELEPHONE (Include Area Code) (513) 255-6644, 8273	22c. OFFICE SYMBOL AFWAL/FIGR

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(2) Pilot-cockpit voice interaction requires a shared information context between the pilot and the cockpit's computer in order to ensure that pilot commands are properly understood and executed. (3) Role-playing works (even with a low-fidelity cockpit simulation) when extracting valuable information from a pilot community. And (4), voice-activated computer messages should not replace pilot-to-pilot communications (radio calls, hand signals) because of the value of knowing that the other pilot (e.g., wingman) actually received the message.

## Preface

This report is the third in the Cockpit Natural Language study series. The first report, Lizza, Munger, Small, Feitshans, and Detro (1987), thoroughly described the purpose and methodology of the study, and it gave the initial data analyses. The second report, Munger, Small and Williamson (1987), described the resulting vocabulary and grammar analyses. This report is a collection of edited transcripts from a subset of the pilot subjects who participated in the original study.

Ms Jerry E. Fogle faithfully transcribed the sessions from cassette tape. Reserve Major Dan E. Flory, a former A-7 pilot and reservist with the Flight Dynamics Laboratory, corrected the initial transcriptions. Mr Bryon T. Hollis, an undergraduate student from Wright State University working part-time in the Crew Systems Development Branch of the Flight Dynamics Laboratory, incorporated Maj Flory's changes. Captain Ronald L. Small did the final transcription edits and authored this report. Dr Michael P. Munger of Midwest Systems Research, Inc and Mr David T. Williamson of the Crew Systems Development Branch provided editorial review.

Artwork for the Cockpit Natural Language study, included as Figures 1 and 2 in this report, was done by Mr Edward T. Kirk of the Crew Systems Development Branch, Flight Dynamics Laboratory. Mr Kirk's scenario rendering was an invaluable aid for the subject pilots because it gave them a visual mission overview and an overall context for their commands and comments.



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## 1.0 INTRODUCTION

### 1.1 Purpose

The transcripts in this report are selected from the Cockpit Natural Language (CNL) study, first reported in Lizza et al (1987). The transcript selection is based upon a subjective evaluation of the quality of the CNL interview session, plus an attempt to capture a cross section of aircraft type. The transcripts included in this report are from the nine subject pilots judged to have contributed the most information and insight about their particular flying environment, and their ideas about the use of advanced computer technologies in fighter cockpits (e.g., color format displays, voice interaction, automation).

These subject pilots are not uniformly supportive of the idea of talking to, and hearing from, their jets. But, they are uniformly expressive and clear in explaining their viewpoints. Their candor and ideas are invaluable for the cockpit design engineering community. That is why this sample of 9 of the 54 pilots interviewed is presented here.

### 1.2 Previous Work

The purpose of the CNL study was to obtain opinions from a cross section of pilots (potential users) about the use of voice interaction in advanced fighter cockpits, and to obtain a set of commands that might be spoken to a listening cockpit. The method used to capture the desired information was a combination of structured interview and low fidelity simulation. The results were better than originally thought possible because the pilots' comments and ideas are so strongly conveyed, and so succinctly stated.

Despite the futuristic (and, at times, unrealistic) scenario (depicted in Figure 1) and the low fidelity "simulation" -- a "slide show" on a portable computer (Figure 2) -- every one of the 54 subjects provided some valuable comments and vocabulary commands. The initial vocabulary is presented in Lizza et al (1987); and, the vocabulary after further refinement is in Munger, Small and Williamson (1987).

### 1.3 Explanation

To maximize the information gleaned from each transcript, the reader should study the scenario description and accompanying graphics (Appendix A). A glossary of terms and acronyms, included as Appendix B, should assist in understanding the pilots' comments. Also, a pilot Biographical Data Form appears at the beginning of each transcript to give the reader an idea of the background, perspective and biases of the pilot.

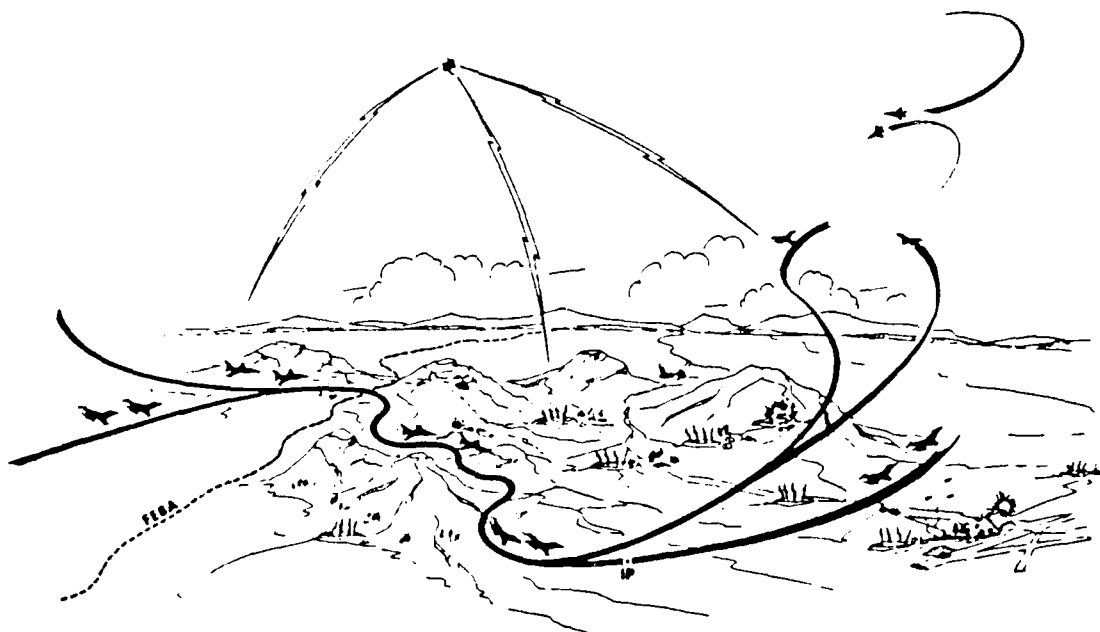


Figure 1. Artist's Rendering of the CNL Scenario

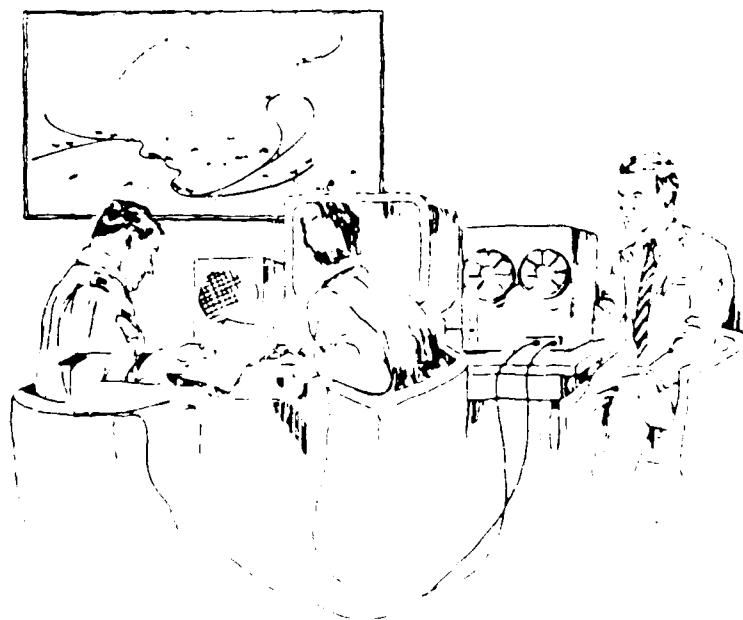


Figure 2. CNL "Simulator"

Besides comments on the use of voice interaction in fighter cockpits, pilots remarked about graphics, automation, and a myriad of other issues. Obviously, not all the suggestions can, or should, be implemented by the cockpit design community; but, each suggestion should be given thoughtful consideration. After all, user acceptance is a key to any successful engineering process. User acceptance is particularly important when engineering a system for use by a highly trained and motivated community whose lives may depend on nuance-level details that only they appreciate or understand.

#### 1.4 Format

The format of each transcript is as follows. The pilot's Biographical Data Form (enumerating flying hours, experience level and variety of aircraft flown) appears first. The actual transcript follows, and has the following speaker codes:

- s    scenario situation number (e.g., s    2.2.4)
- e    experimenter's comments or explanations
- p    pilot's comments or explanations
- c    pilot's command to cockpit, based on the sequencing of the scenario
- o    pilot's other command, not based on the sequencing of the scenario
- v    computer voice output.

#### 1.5 Lessons Learned

Since this is the third of three technical reports based on the Cockpit Natural Language study, it seems appropriate to describe the lessons learned from this research effort.

The single most important message from the CNL study is that the knowledge context (goals, intentions and situational awareness) of the pilot is crucial to understanding the semantics of the commands. This lesson is particularly appropriate in an environment where jargon, brief phrases, noise and a sense of urgency are pervasive. To understand the pilots' commands and comments, the reader should read the scenario description first, refer to the graphics often, and try to visualize what the subject pilots are imagining as they talk their way through the scenario. Similarly, any aircraft computer designed to accept pilot commands must have sufficient knowledge of the environment to understand and correctly execute pilot commands.

The second most important lesson to learn from the CNL study is that voice interaction is best employed as a new channel of information transfer, not just as a backup mode for manual or visual channels. Voice should be used at the intent level, commanding many aircraft subsystems to act in support of the pilot's stated intentions. For example, a command like "avoid SAM" means "re-plan route and altitude to avoid enemy surface-to-air missile detection." Voice is also good for commanding multiple aircraft subsystems simultaneously. For example, "fence check" means "set all the pre-designated subsystems to the proper mode for flight into enemy airspace." Voice commands should not replace single switch actuations (e.g., "select air-to-air missile") because manual actuations are quicker and, currently, more reliable than verbal actuations. Using voice interaction as a new information transfer channel allows pilots to keep their manual and visual channels devoted to such critical activities as watching an enemy aircraft, flying and shooting.

Another lesson is that computer-synthesized voice messages should not replace pilot-to-pilot communications (radio calls, hand signals) because of the value of hearing and recognizing the other pilot's (e.g., wingman's) voice. When pilots fly coordinated tactics affecting the success of the mission, they need to know that the other pilot received the communication. A computer synthesized voice message does not provide the needed assurance that the other pilot, not just the other pilot's computer, received the message. Of course, data-link messages could faithfully reproduce a pilot's voice to provide the expressly-desired level of assurance.

Another important lesson from this study is that asking pilots to role-play in a futuristic scenario works. Of the 54 subjects who participated in the study, only two had difficulty relating to the scenario and the tasks they were asked to accomplish. Perhaps the current wide use of simulators by pilots contributes to their willing suspension of disbelief. Whatever the cause, the study would have been a failure without the pilots' willingness to role-play.

The other lesson worth relating is that transcripts are hard to do. The average scenario session lasted 1.5 hours. Initial transcripts averaged 15 hours per session. Editing to the form presented herein took another 30 hours per tape. This 30-to-1 ratio caused many schedule changes and culminated in this report being 6 months behind schedule. In hindsight, it was unexpectedly clever to have the tape recorder operator write the pilot commands during the sessions. Otherwise data, vocabulary and grammar analyses would still not be accomplished.



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Lizza, G.D., Munger, M.P., Small, R.L., Feitshans, G.L. & Detro, S.D. (1987). A Cockpit Natural Language Study: Data Collection and Initial Data Analysis. AFWAL-TR-87-3003 Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Dayton, OH. (DTIC# A181306)

Munger, M.P., Small, R.L. & Williamson, D.T. (1987). A Cockpit Natural Language Study: Vocabulary and Grammar Analyses. AFWAL-TR-87-3108, Flight Dynamics Laboratory Wright-Patterson Air Force Base, Dayton, OH.

## APPENDIX A

### VOICE TECHNOLOGY SCENARIO INSTRUCTIONS

Here is the way we are going to take you through the scenario. The chart sitting on top of the computer gives you a kind of bird's eye view of the whole scenario (see Figures 1 and 2 on page 2 of this report). As you are flying along carrying out your mission, you will encounter approximately 40 situations where you will have to decide what you are going to do next. As each new situation crops up, we will call a halt and collect some information from you. In other words, we will kind of "freeze-frame" our way through the mission, taking a break at each situation before proceeding to the next one.

In general, a situation is a collection of information describing where you are in the mission, the status of your aircraft, where your friends and foes are, and so-forth. By and large, you are carrying this information around in your head, but new information is constantly cropping up. It generally comes from internal sensors, external sensors, data-links with ground control and other aircraft, and so-on.

We will provide this new information to you in several ways: (1) the document you are holding contains a narrative description of what is going on; (2) the computer screen will show some graphics which are a rough approximation of the sorts of radar and status displays you are used to seeing or will be seeing in the future; and (3) a limited amount of voice output from the computer. The graphics you see and the voice you hear are simply our way of jazzing up the scenario somewhat, to make it a little bit more "real" than just reading a story line. Don't think for a minute that what we cooked up for you in any way represents what we think the future will be like.

In summary, then, going through the scenario involves about 40 repetitions of the following three events: (1) giving you some information defining a new situation; (2) letting you mull it over; and (3) getting some information from you in return. Although this seems straightforward enough, there are some things we want you to keep in mind.

Remember that you are role-playing, so try to get yourself into the spirit of things. Those of you who have ever played Dungeons and Dragons with your kids know what we mean. It's what the literary folks call "willing suspension of disbelief," the ability not to get hung up on discrepancies between the role you are playing and what you know about the "real" world. For example, you may not know exactly where the information comes from that defines a new situation; it could be JTIDS, an external sensor, your wingman talking to you, or whatever. Don't worry about it. Just assume that it's good stuff and go with it.

Now for some specifics. Each time a new situation crops up, it is identified in the document you are holding by the word "Aircraft." It is followed by some narrative description and is probably accompanied by some changes in the computer graphics and perhaps some voice output. In the document it might look something like this:

2.2.1 Aircraft:

Reports new threat popped up,  
SAM threat at 12 o'clock

This is where we take a break and let you think things over. Take a minute to browse around in the scenario to see how this material is presented.

Up to now the new situation has meant giving information to you. Now it's your turn to give some to us.

1) Assess the situation.

Describe your understanding of the situation, your chief concerns or worries, and what it is you want to accomplish. This may seem kind of repetitious, especially the part about describing the situation, but it really isn't. As an expert in these matters, you will choose to emphasize some things and de-emphasize or even ignore others. This is exactly what we want to find out.

2) Give verbal instructions to your aircraft.

This is really going to put your role-playing ability to the test. Normally you would be pushing buttons or flipping switches to get things done. Now we are asking you to issue verbal instructions. The easiest way to do this is to assume that you are speaking to another human being, a back-seater, perhaps, who understands everything you say and will promptly carry out your orders. Feel free to use whatever technical words or communication jargon you think is appropriate. The narrative will indicate the general content of command you are to give. We are going to ask you to give two separate instructions. The first one will be what you think is appropriate, given your perception of the situation and your goals. The second one will be based on what we suggest to you. This is necessary so that certain content areas are covered. What you come up with and what we suggest may or may not be the same. Don't worry about it; there is no right or wrong here on either side.

NOTE: THROTTLE, STICK, AND RUDDER ARE SPECIFICALLY EXCLUDED!

3) Answer questions

For each of the rating categories listed below, evaluate the use of verbal commands compared to the methods you normally employ.

	Very Poor	Poor	Same	Good	Very Good
speed :	:	:	:	:	:
conflict :	:	:	:	:	:
workload :	:	:	:	:	:
usefulness :	:	:	:	:	:

Each of the rating categories is to be interpreted as follows:

- speed: how quickly were you able to communicate with your aircraft
- conflict: how much conflict was there with any other tasks you had to carry out at the same time
- workload: what sort of effect did using voice have on your workload
- usefulness: how useful was this technique in this situation

Remember that these ratings are to be made compare to the methods you normally use.

We are going to be tape recording your verbal responses. This might seem a little threatening, but you can relax. The recordings are going to be transcribed by a secretary onto floppy disks for computer analysis. Your name will not appear anywhere. As much as we appreciate your efforts in this study, we are interested in your words, not you.

Before we actually run you through the scenario, we want to try you out on a practice situation. We want to make sure that you understand what is expected and give you a chance to get used to the procedures. It also gives us one last chance to check out our equipment.

## SCENARIO OVERVIEW

The scenario begins with two advanced fighters flying a prestrike sweep. Two attack aircraft compose the strike element. The attack aircraft are responsible for attacking an airfield and are configured with stores for this role. The fighters have been assigned to clear the area of airborne threats. They are configured for air combat: long range air intercept missiles (AIMs), short range AIMs, and guns. They also have anti-radiation missiles (ARMs) for protection from radar guided ground threats, electronic countermeasure pods, chaff, and flares.

Your aircraft in the scenario is the lead fighter aircraft. Based on your assessment of the overall tactical situation, you have elected to keep the fighters low during the initial penetration.

The attack and fighter aircraft are flying separately in twoship formations and will rendezvous just before crossing the forward edge of battle area (FEBA). After rendezvous the fighters and attack aircraft will descend to 200 feet, cross the FEBA, and fly down a heavily defended valley. The fighters will be in trail formation two miles apart. The attack aircraft, also in twoship formation, will follow by two to three miles.

Before reaching the target area, the fighters are assigned to intercept an enemy combat air patrol (CAP) that poses a long range threat to the strike. As the fighters climb out to begin the beyond visual range (BVR) intercept, they receive sensor and data-link reports concerning several groups of aircraft operating within a 200-nautical mile radius of their location. As the aircraft come within radar range, they are sorted, identified, and targeted. Ownship and wingman then fire long range AIMs at the enemy formation and quickly turn to escape. The enemy aircraft are destroyed. Additionally, the strike aircraft report weapons delivery.

The scenario is divided into six segments:

- 1.0 APPROACH TO COMBAT AREA
- 2.0 PENETRATION AT LOW LEVEL
- 3.0 DIVERT TO AIR-TO-AIR INTERCEPT
- 4.0 CLOSE ON TARGET FORMATION
- 5.0 LAUNCH AGAINST TARGETS
- 6.0 RETURN TO BASE

If you have any questions, now is a good time to get them off your chest. Your mission is about to begin.

## VOICE TECHNOLOGY SCENARIO

### Situation 1.2.2

#### Description:

Pilot is in lead, descending in weather through 5000 feet, with wingman in trail. A planned waypoint is being crossed en route to rendezvous with two fighter bombers.

Voice from aircraft before command:

"Rendezvous data."

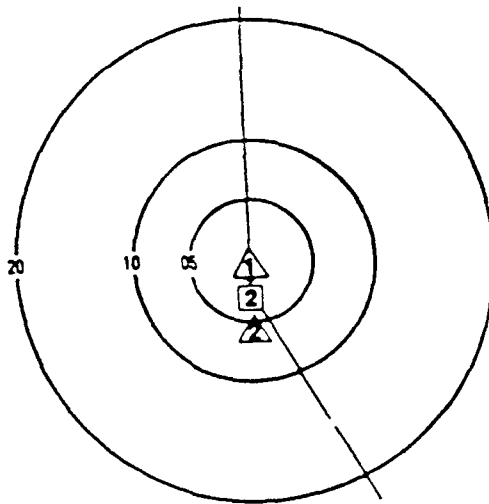
Experimenter's prompt for command:

Request detailed rendezvous data.

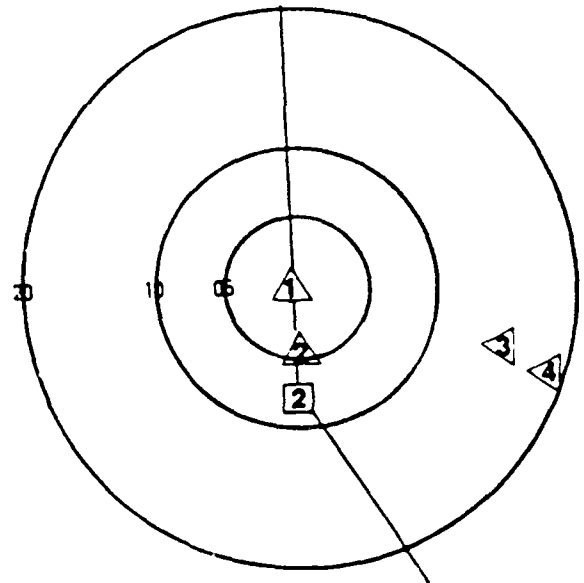
Voice response from aircraft after command:

"Sabre 41 at 14 miles and closing."

Display at start



Display at finish



### Situation 1.3.2

**Description:**

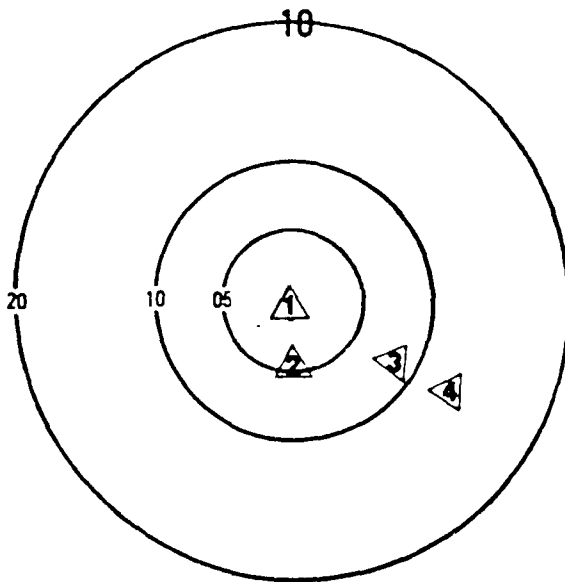
Pilot is approaching rendezvous. A data link message has been received concerning down range threats.

Voice from aircraft before command:  
"Threat data."

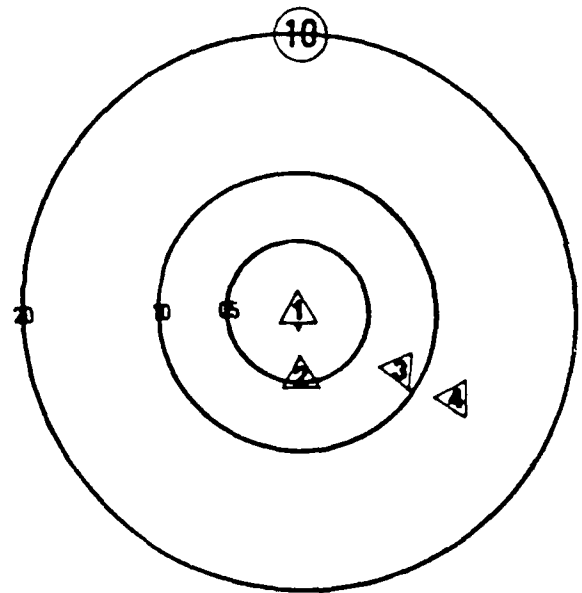
Experimenter's prompt for command:  
Request details on threat data.

Voice response from aircraft after command:  
"Tracking J band."

Display at start



Display at finish



### Situation 1.4.1

**Description:**

The threat is real and must be dealt with, but rendezvous heading should be maintained.

**Voice from aircraft before command:**

None.

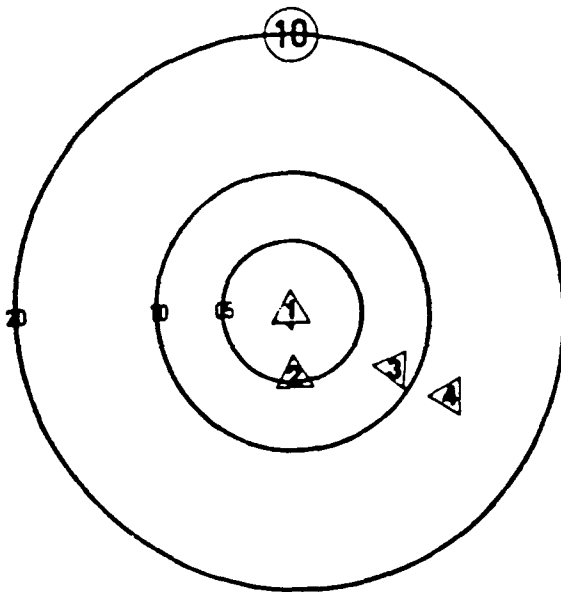
**Experimenter's prompt for command:**

Request display of countermeasure options.

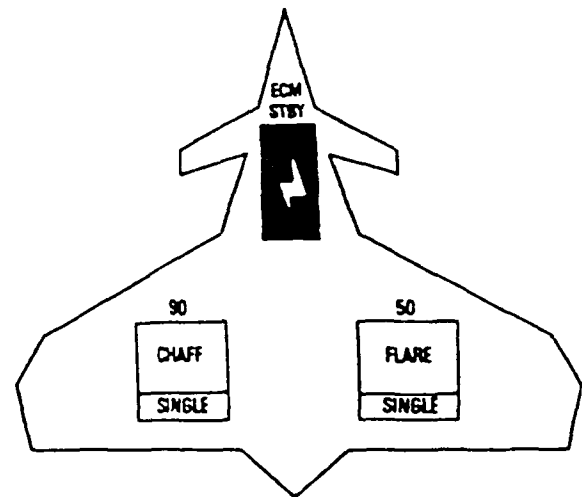
**Voice response from aircraft after command:**

None.

Display at start



Display at finish





### Situation 1.4.3

**Description:**

Aircraft displays all countermeasure options: chaff, flares and ECM.

Voice from aircraft before command:

None.

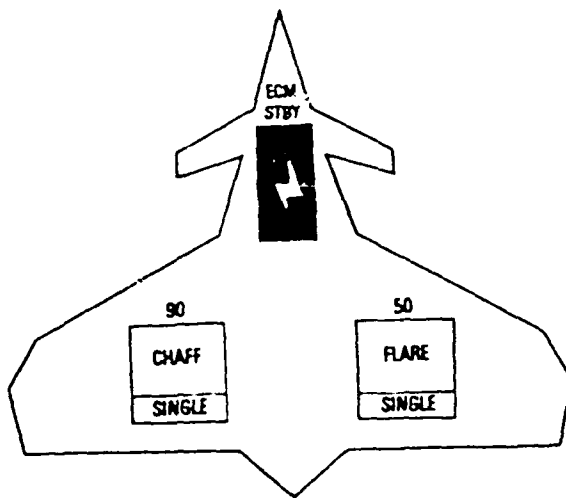
Experimenter's prompt for command:

Select ECM and chaff.

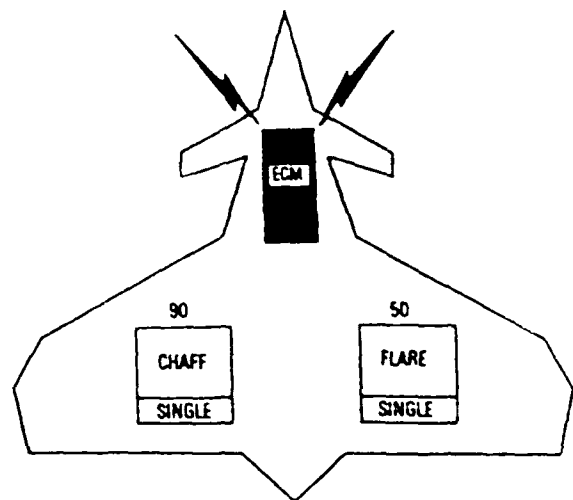
Voice response from aircraft after command:

"ECM and chaff selected; threat no factor."

Display at start



Display at finish



## Situation 1.5.2

### Description:

Countermeasures have been effective. Rendezvous point has been reached and more information is available upon request.

Voice from aircraft before command:

"Rendezvous data."

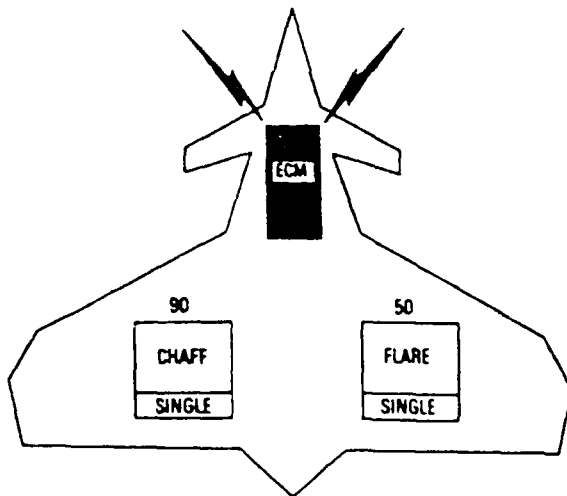
Experimenter's prompt for command:

Request data on other flight.

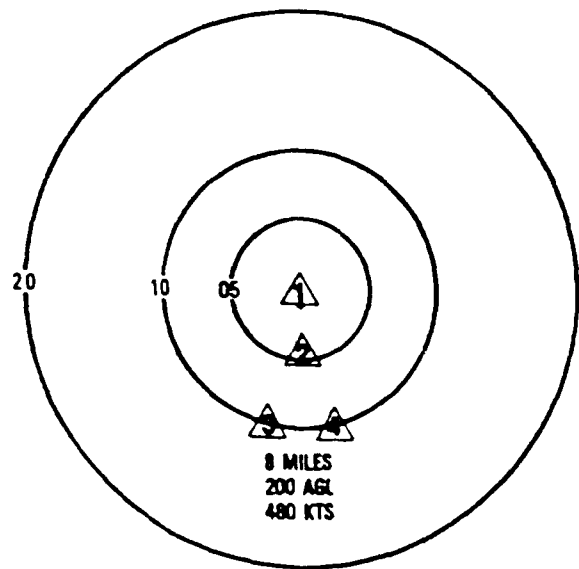
Voice response from aircraft after command:

None.

Display at start



Display at finish



### Situation 1.5.5

**Description:**

Rendezvous is complete and the system requests permission to run a fence check within 25 miles of the FEBA.

**Voice from aircraft before command:**

"Consent for fence check."

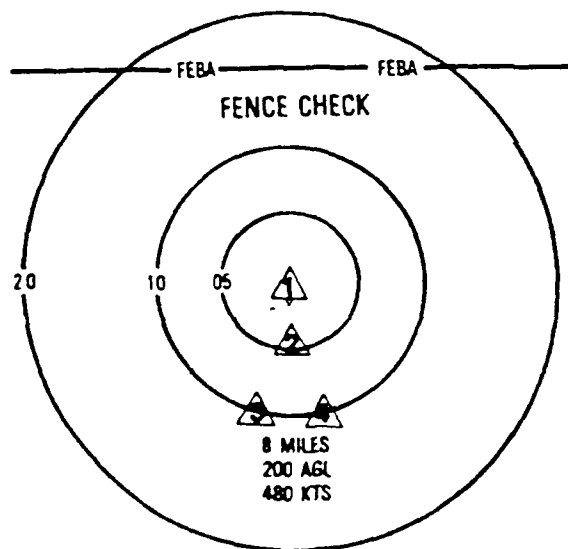
**Experimenter's prompt for command:**

Request fence check.

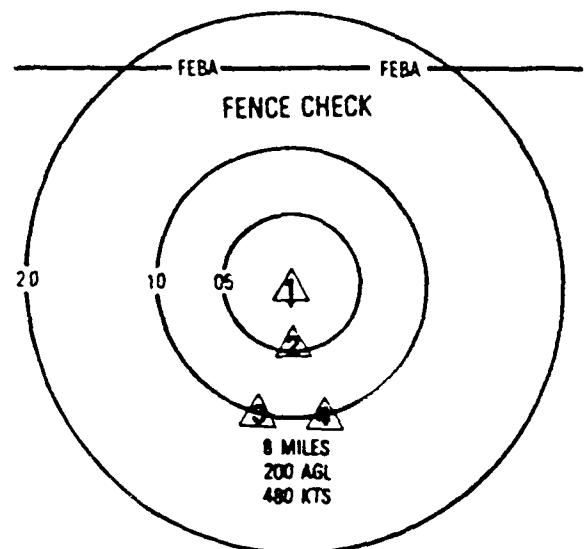
**Voice response from aircraft after command:**

"Fence check complete."

Display at start



Display at finish



### Situation 1.6.1

**Description:**

Initiating transition to low level requires a check of the status of the terrain following equipment.

Voice from aircraft before command:

None.

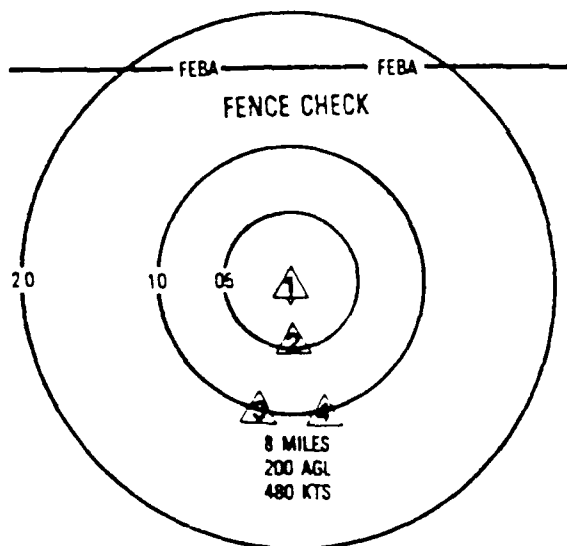
Experimenter's prompt for command:

Request TF status checks.

Voice response from aircraft after command:

None.

Display at start



Display at finish

TF RADAR STATUS			OK
LPI	SCP	200	
	ALOW	100	
MANUAL		AUTO	

### Situation 1.6.3

**Description:**

TF status checks have been completed successfully. Auto or manual mode must be selected.

Voice from aircraft before command:  
None.

Experimenter's prompt for command:  
Request auto TF/TA.

Voice response from aircraft after command:  
"Auto."

Display at start

TF RADAR STATUS			OK
LPI	SCP	200	
	ALOW	100	
MANUAL		AUTO	

Display at finish

TF RADAR STATUS			OK
LPI	SCP	200	
	ALOW	100	
MANUAL		AUTO	

## Situation 2.1.2

### Description:

Low level transition is complete and current threats are displayed.

Voice from aircraft before command:

"Threat data."

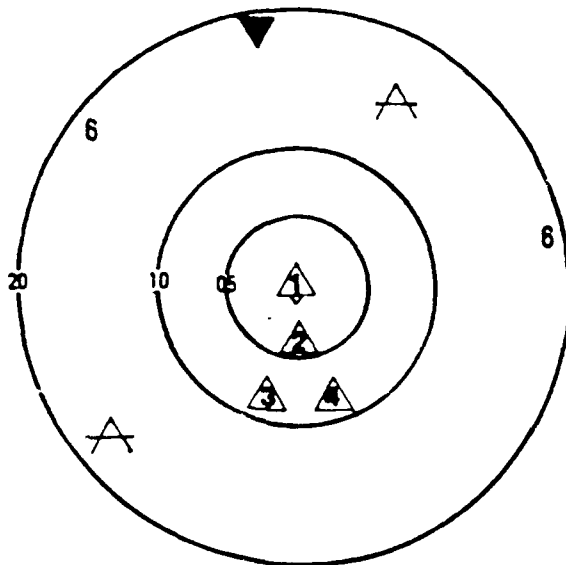
Experimenter's prompt for command:

Request detailed threat information.

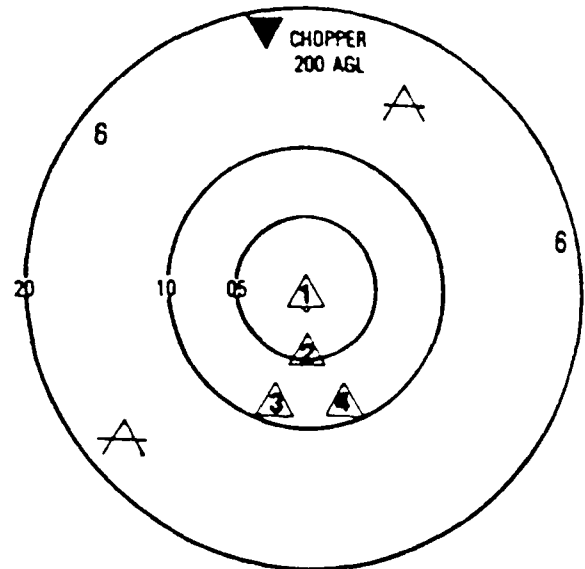
Voice response from aircraft after command:

"Helicopter 18 miles, 12 o'clock, and closing."

Display at start



Display at finish



#### Situation 2.1.4

**Description:**

System identifies a low level helicopter with probable air-to-air capabilities, on flight path and closing.

Voice from aircraft before command:

None.

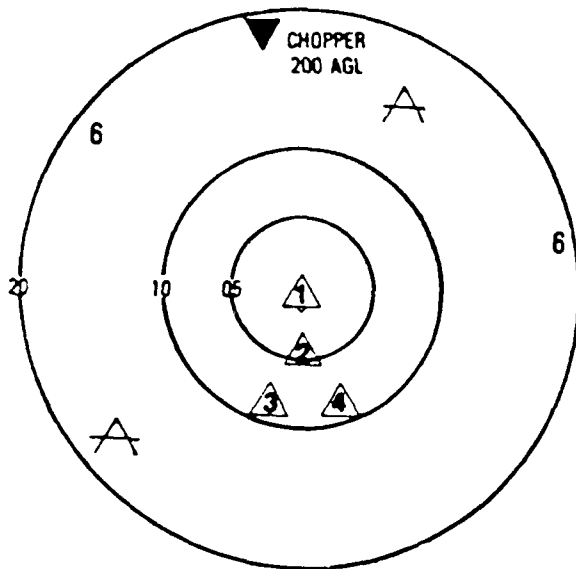
Experimenter's prompt for command:

Request long range AIM.

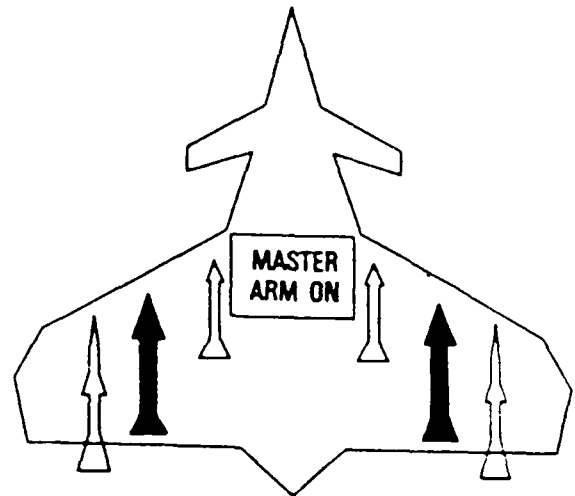
Voice response from aircraft after command:

"Master arm on."

Display at start



Display at finish



### Situation 2.1.6

**Description:**

Missiles are selected and ready.

**Voice from aircraft before command:**

None.

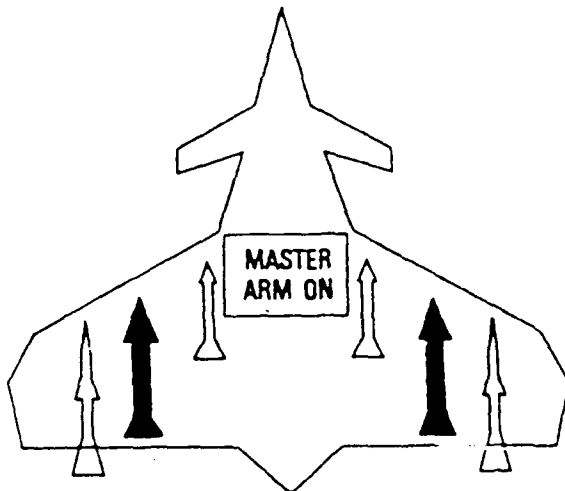
**Experimenter's prompt for command:**

Request radar lock on target.

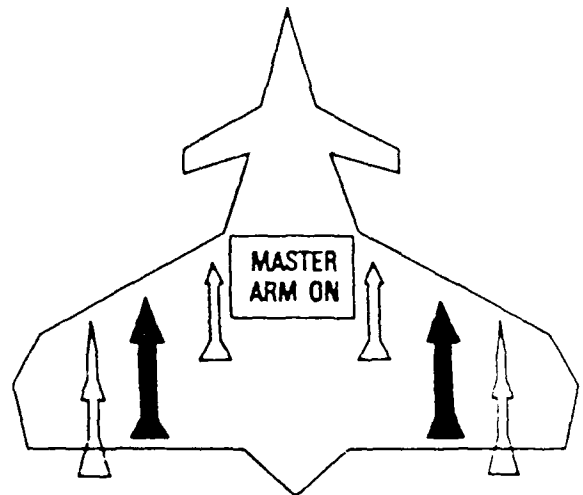
**Voice response from aircraft after command:**

"Radar locked, in range, optimum 5 seconds."

Display at start



Display at finish





### Situation 2.2.2

**Description:**

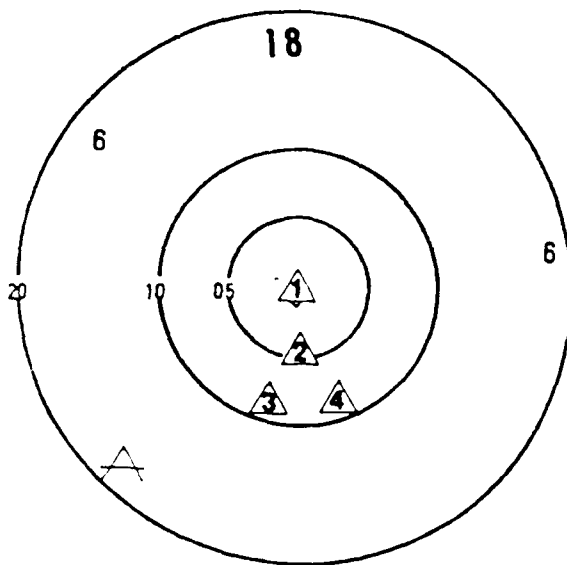
The helicopter has been shot down. The battle has highlighted the aircraft's position and a new threat is now tracking.

Voice from aircraft before command:  
"Threat data."

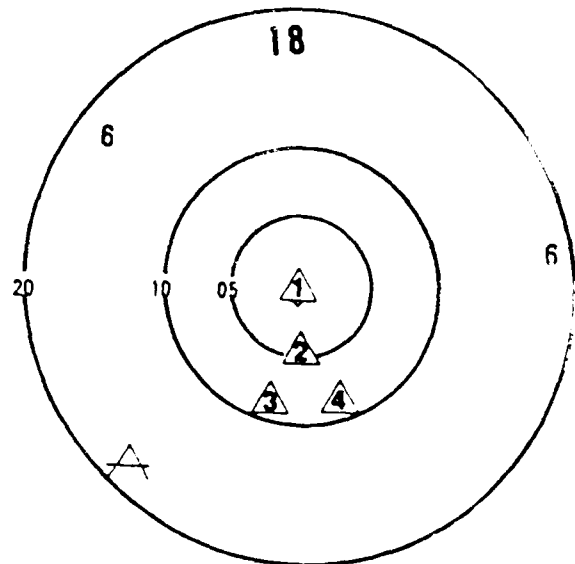
Experimenter's prompt for command:  
Request details on threat data.

Voice response from aircraft after command:  
"ECM ineffective, reroute available."

Display at start



Display at finish



#### Situation 2.2.4

**Description:**

ECM is ineffective against the SAM threat and reroute information is available.

Voice from aircraft before command:

None.

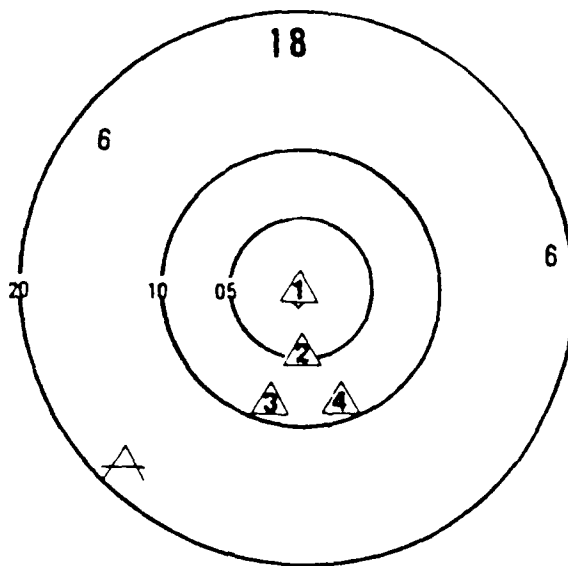
Experimenter's prompt for command:

Request details on reroute.

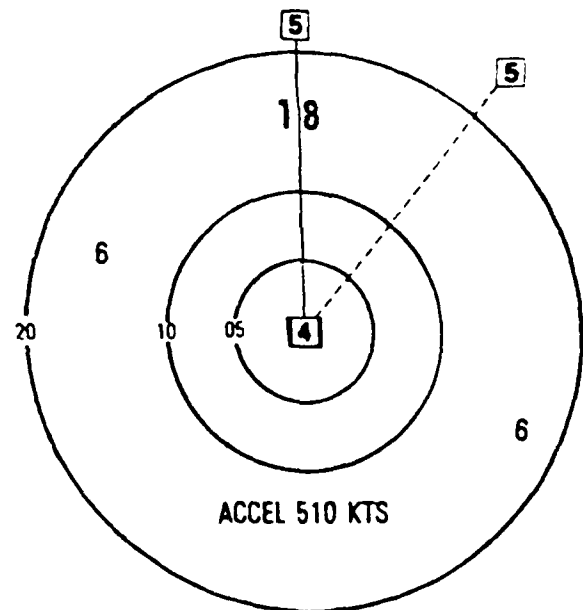
Voice response from aircraft after command:

None.

Display at start



Display at finish



### Situation 2.2.6

**Description:**

Aircraft displays alternate route with adjusted air speed to make time on target.

**Voice from aircraft before command:**

None.

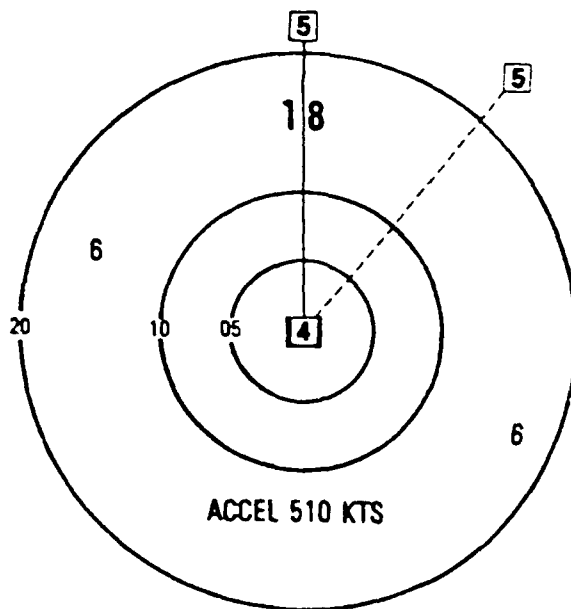
**Experimenter's prompt for command:**

Request pass to 2, 3, and 4.

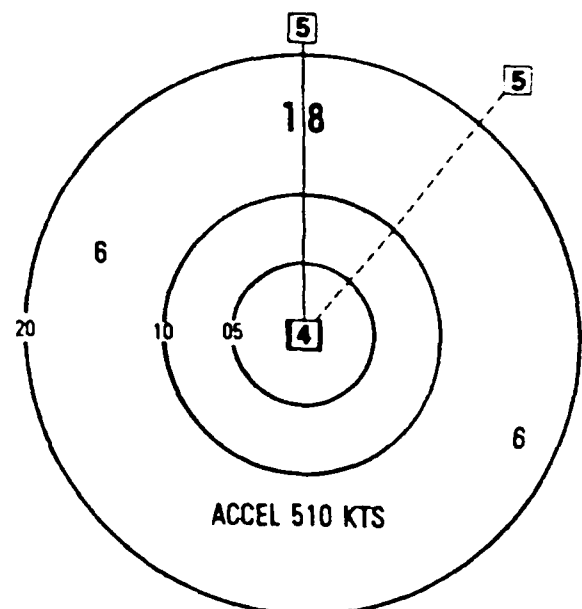
**Voice response from aircraft after command:**

"Message sent."

Display at start



Display at finish



### Situation 3.1.2

Description:

JTIDS reports new air threat, identifying location, direction, speed, and altitude.

Voice from aircraft before command:

None.

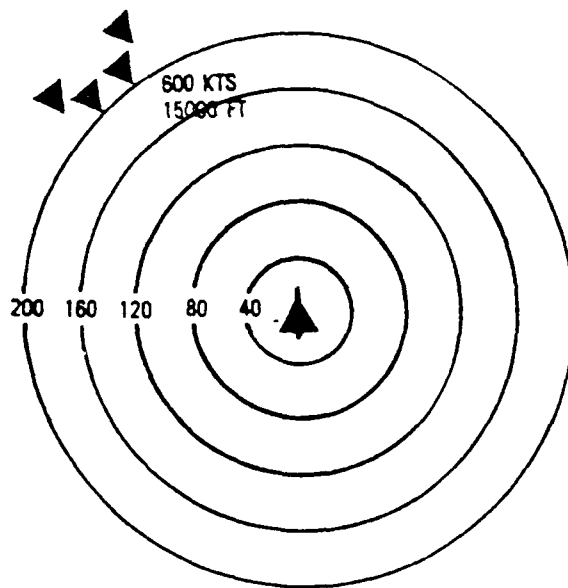
Experimenter's prompt for command:

Request reconfiguration of aircraft for air-to-air BVR.

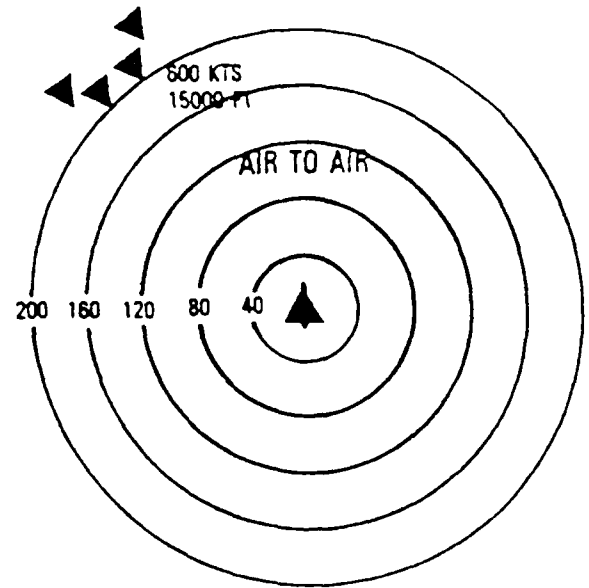
Voice response from aircraft after command:

"Configured air-to-air."

Display at start



Display at finish



#### Situation 3.1.4

Description:

The aircraft remodes for air-to-air, displaying only suspected airborne targets.

Voice from aircraft before command:

None.

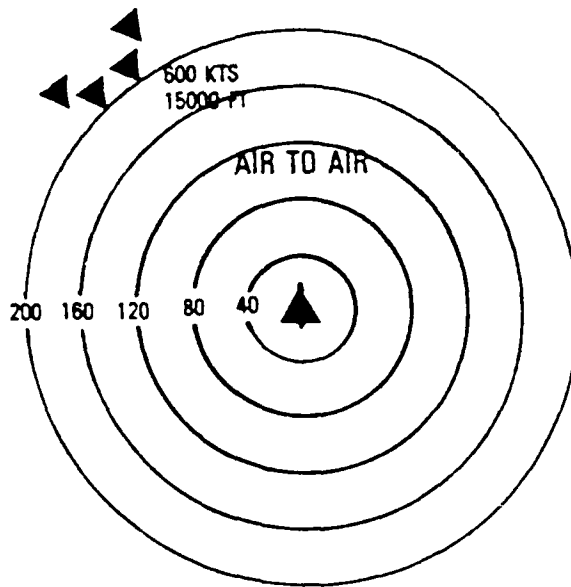
Experimenter's prompt for command:

Request setup of long range AIM.

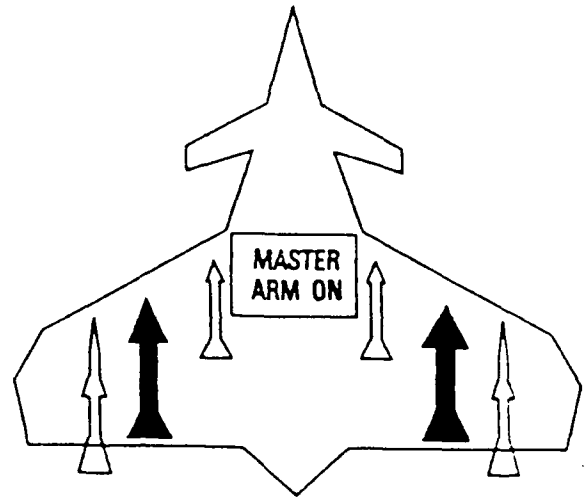
Voice response from aircraft after command:

"Master arm on."

Display at start



Display at finish



### Situation 3.1.6

**Description:**

Long range AIM has been selected to counter airborne threat and radar is in standby.

Voice from aircraft before command:

"Master arm on."

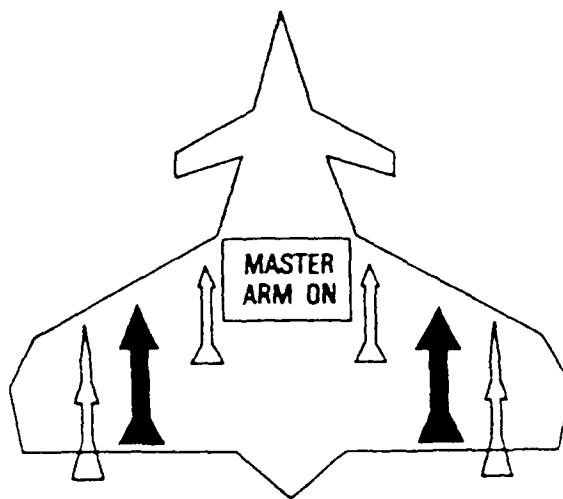
Experimenter's prompt for command:

Select infra-red search and track.

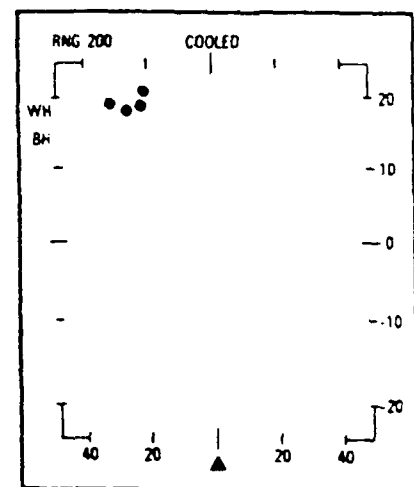
Voice response from aircraft after command:

None.

Display at start



Display at finish



### Situation 3.2.1

**Description:**

The threat is being sorted. Four heat sources are displayed at 22 degrees left, 20 degrees high, 185 miles.

**Voice from aircraft before command:**

None.

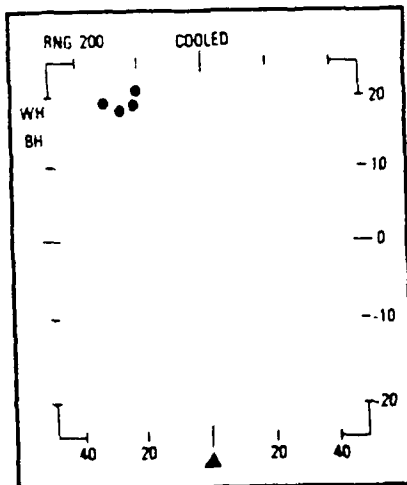
**Experimenter's prompt for command:**

Request detailed information.

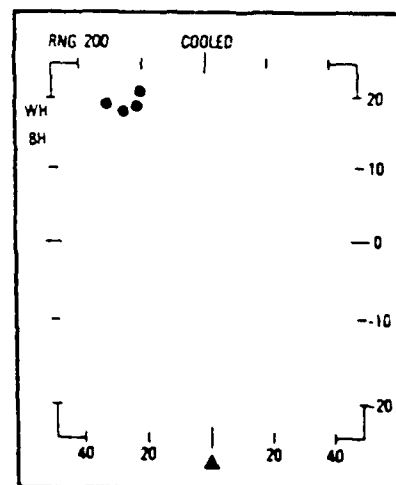
**Voice response from aircraft after command:**

"Hostile."

Display at start



Display at finish



### Situation 3.2.3

Description:

The system identifies suspect formation as an enemy.

Voice from aircraft before command:

None.

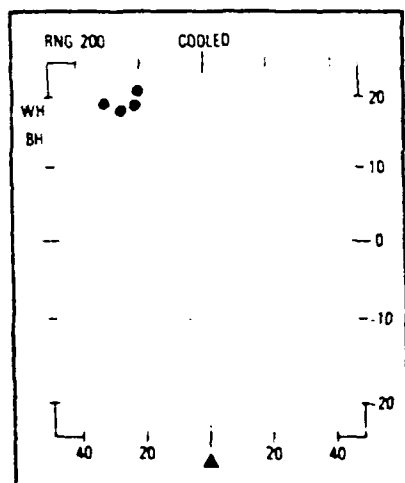
Experimenter's prompt for command:

Request close up view.

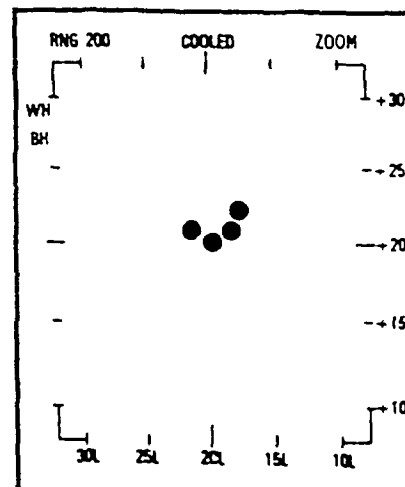
Voice response from aircraft after command:

None.

Display at start



Display at finish





### Situation 3.2.5

**Description:**

An expanded view of the four enemy aircraft is given.

**Voice from aircraft before command:**

None.

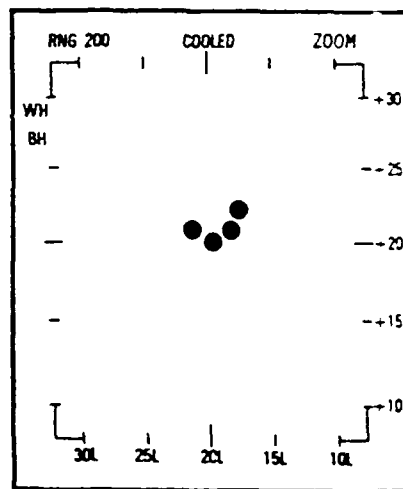
**Experimenter's prompt for command:**

Request track analysis.

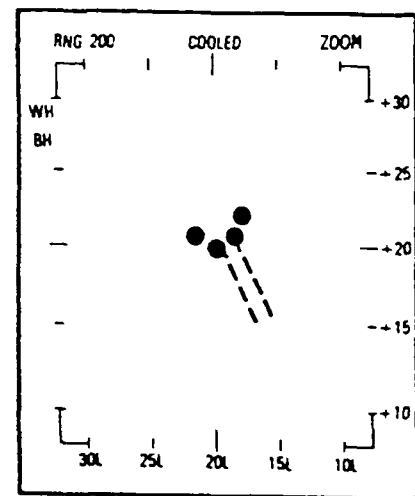
**Voice response from aircraft after command:**

"In range for air-to-air radar."

Display at start



Display at finish



### Situation 3.2.7

**Description:**

The projected flight path of the enemy is added to the display. They are determined to be in range for air-to-air radar.

Voice from aircraft before command:

None.

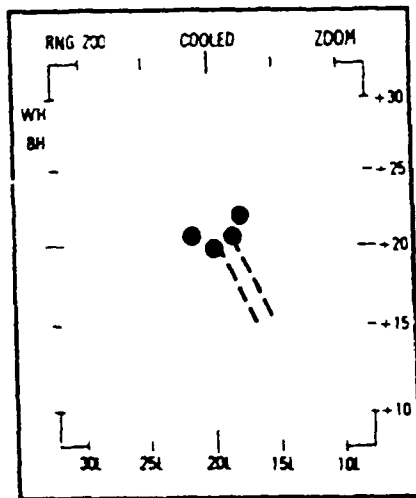
Experimenter's prompt for command:

Request air-to-air radar.

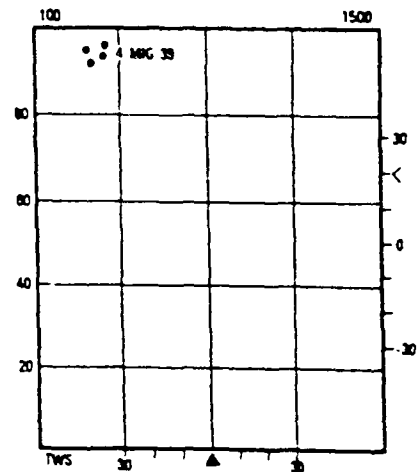
Voice response from aircraft after command:

None.

Display at start



Display at finish



### Situation 3.2.9

**Description:**

The aircraft confirms enemy aircraft threat. Optimal intercept profiles are developed and available.

Voice from aircraft before command:

None.

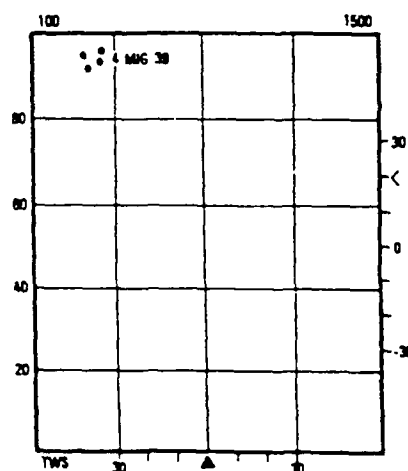
Experimenter's prompt for command:

Request intercept options.

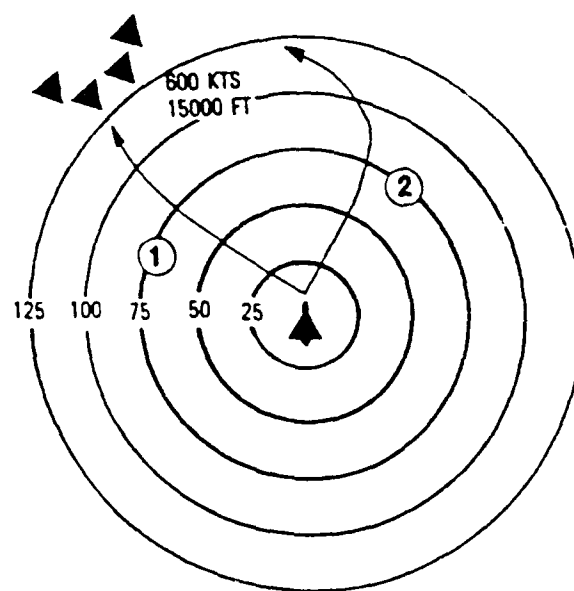
Voice response from aircraft after command:

None.

Display at start



Display at finish



### Situation 3.2.11

**Description:**

Displays two options:

- 1) short time to engage, PK of .5
- 2) longer time to engage, PK of .98.

Voice from aircraft before command:

None.

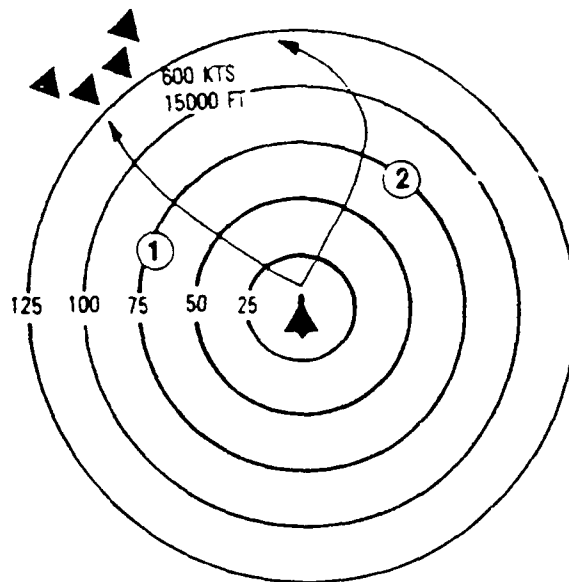
Experimenter's prompt for command:

Request second intercept option.

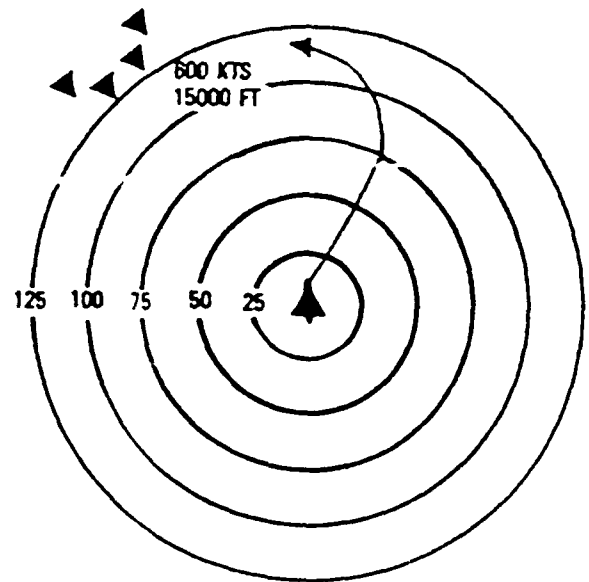
Voice response from aircraft after command:

None.

Display at start



Display at finish



### Situation 3.2.13

Description:

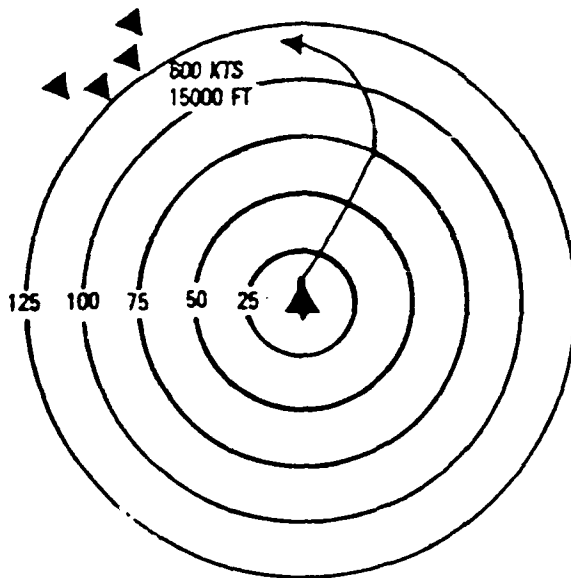
Option 2 is selected. Wingman needs to be advised of intercept heading and tactics.

Voice from aircraft before command:  
None.

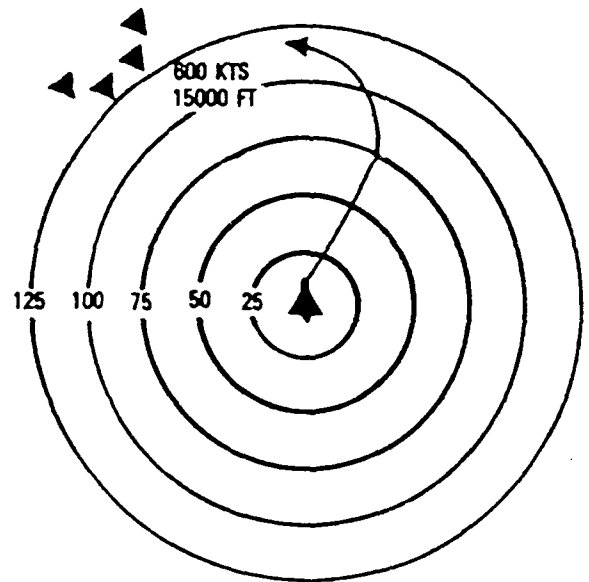
Experimenter's prompt for command:  
Request transmission of plan to wingman.

Voice response from aircraft after command:  
"Message sent."

Display at start



Display at finish



### Situation 3.2.15

**Description:**

The commitment to the selected engagement tactic has been made. Status of attack flight is required.

**Voice from aircraft before command:**

None.

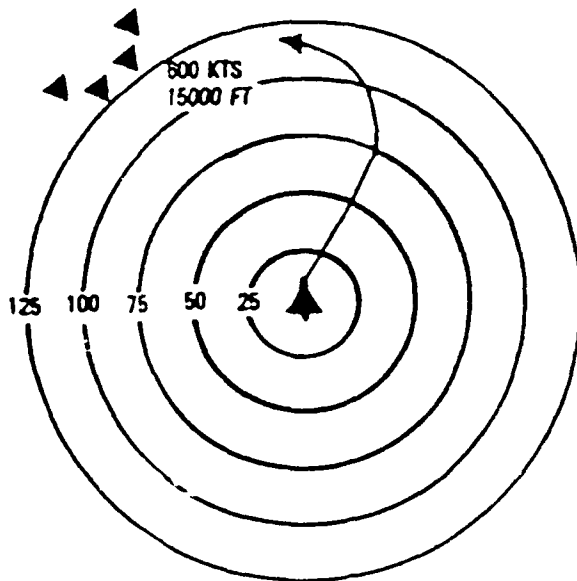
**Experimenter's prompt for command:**

Request confirmation of bombers' navigation situation.

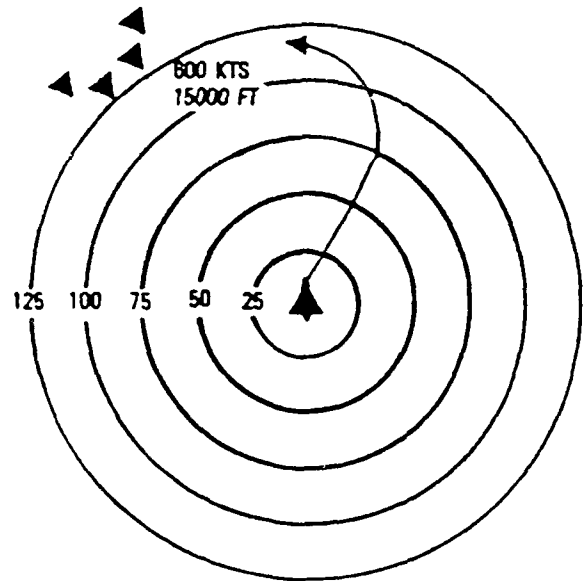
**Voice response from aircraft after command:**

"IP inbound."

Display at start



Display at finish



### Situation 3.3.1

**Description:**

Fighter-bombers are inbound at the IP and require defense of the air-to-air threat to accomplish their mission.

Voice from aircraft before command:

None.

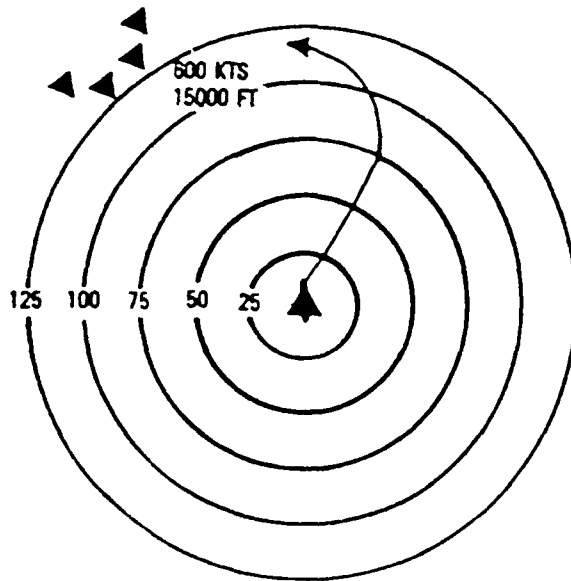
Experimenter's prompt for command:

Request intercept vectors.

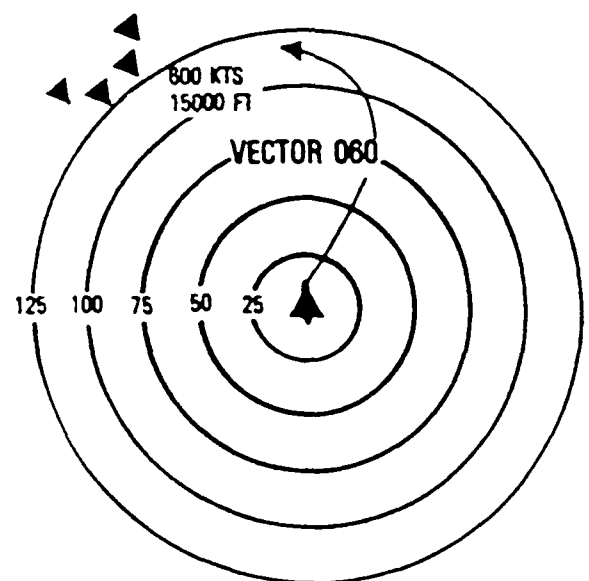
Voice response from aircraft after command:

"Vector 060."

Display at start



Display at finish



### Situation 3.3.3

**Description:**

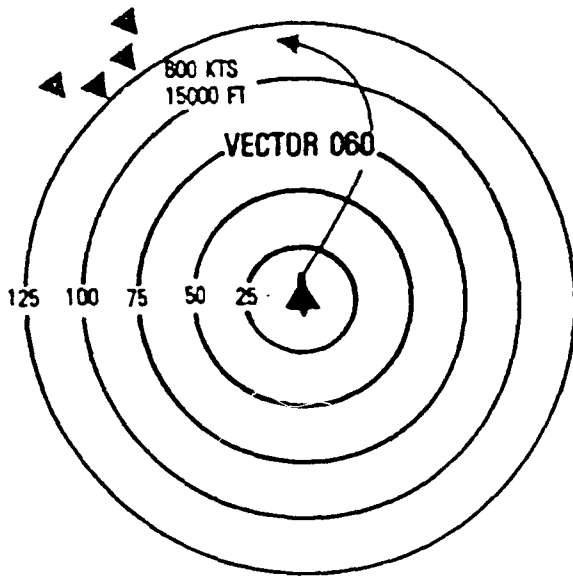
Half way through the stern conversion, the enemy is not maneuvering. It is time to split the flight and assign targets.

Voice from aircraft before command:  
None.

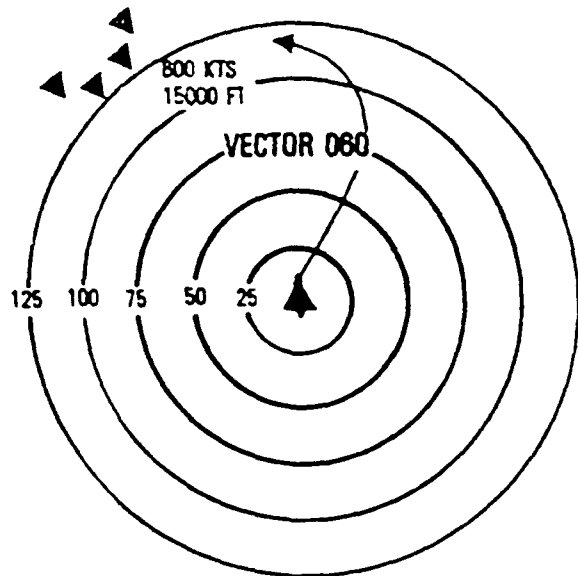
Experimenter's prompt for command:  
Request wingman to deploy.

Voice response from aircraft after command:  
"Message sent."

Display at start



Display at finish





### Situation 4.1.2

Description:

Target assignment and prioritization must now be accomplished.

Voice from aircraft before command:

"Target assignment ready."

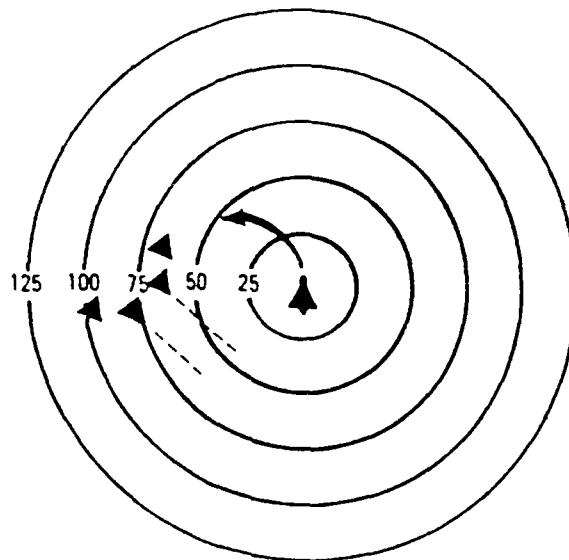
Experimenter's prompt for command:

Request assignment display.

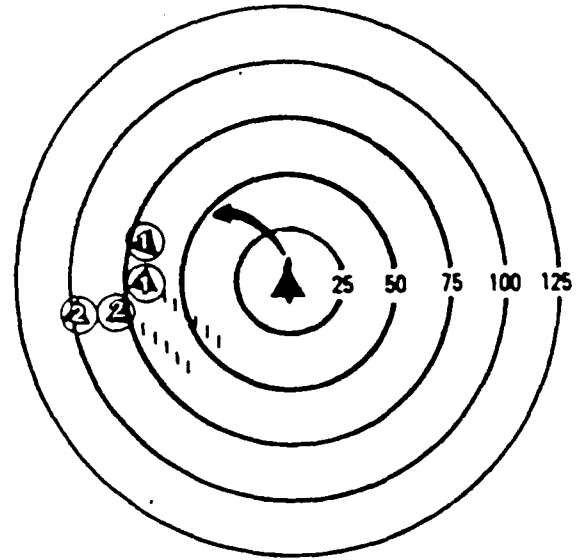
Voice response from aircraft after command:

None.

Display at start



Display at finish



#### Situation 4.1.4

Description:

Display advises assignment of lead to the two aircraft on the right, wingman to the two on the left.

Voice from aircraft before command:

None.

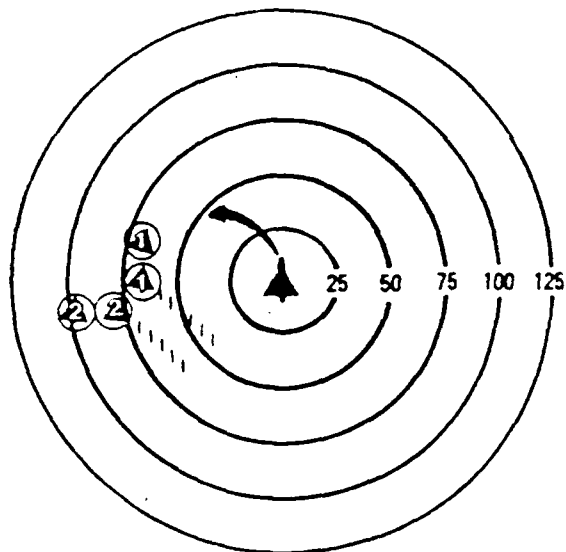
Experimenter's prompt for command:

Confirm assignment.

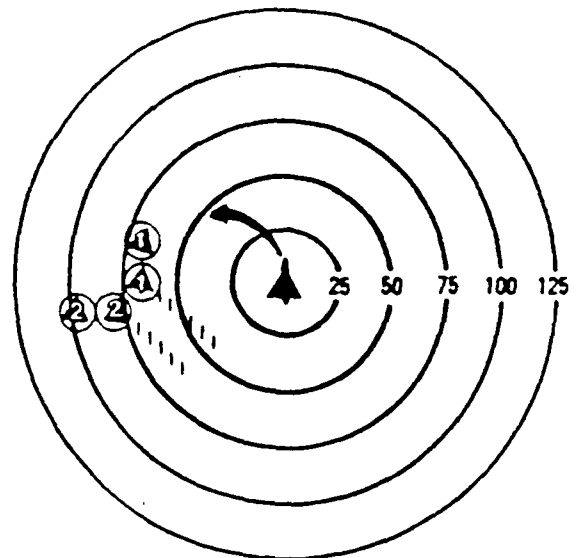
Voice response from aircraft after command:

"Message sent."

Display at start



Display at finish



### Situation 5.1.2

**Description:**

The enemy formation splits, target #1 converging on own flight and target #2 heading for attack flight.

**Voice from aircraft before command:**

"Targets crossed."

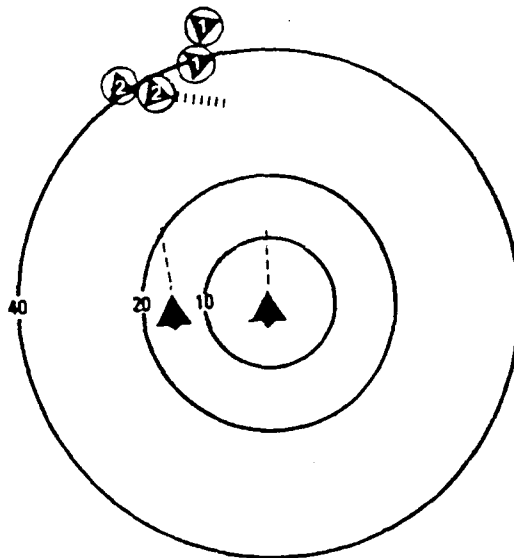
**Experimenter's prompt for command:**

Reassign target #2 to ownship, target #1 to wingman.

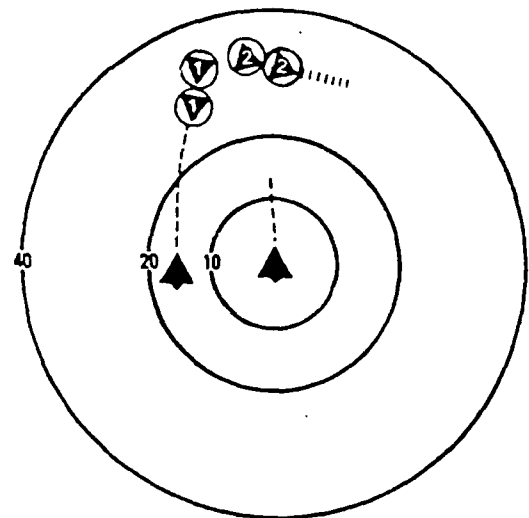
**Voice response from aircraft after command:**

None.

Display at start



Display at finish



#### Situation 5.1.4

**Description:**

Aircraft displays new target assignments.

Voice from aircraft before command:

None.

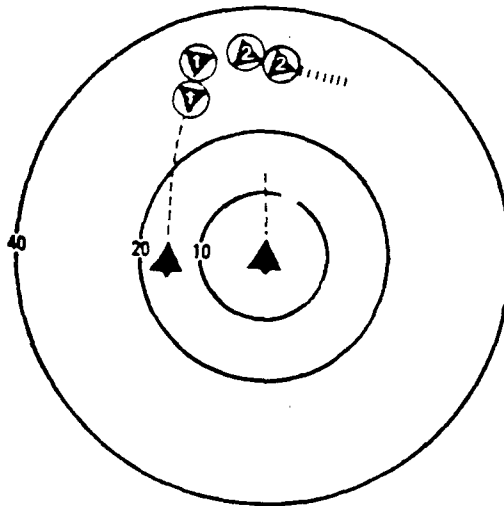
Experimenter's prompt for command:

Request pass to flight.

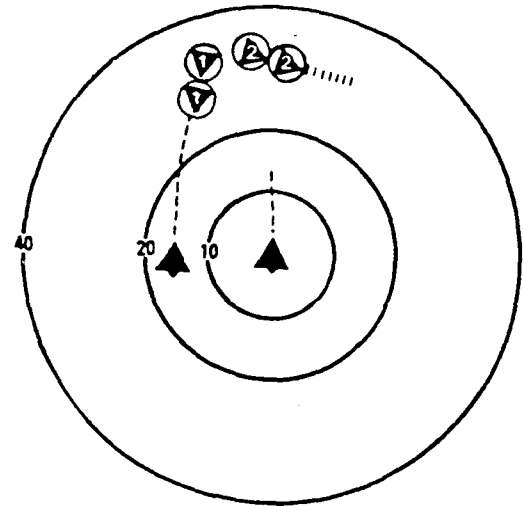
Voice response from aircraft after command:

"Message sent."

Display at start



Display at finish



### Situation 5.2.2

**Description:**

Aircraft advises that target will be in range in 10 miles.

**Voice from aircraft before command:**

"Target in range in 10 miles."

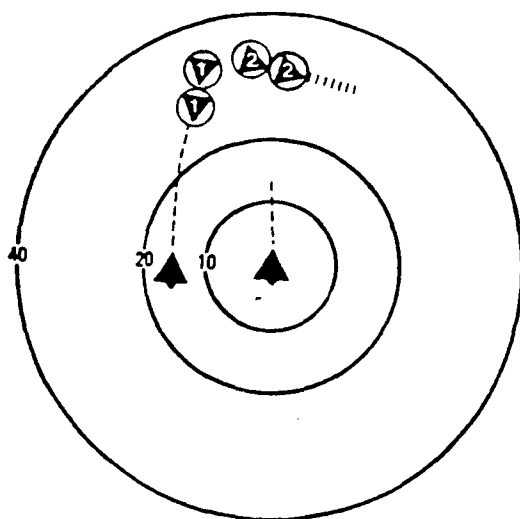
**Experimenter's prompt for command:**

Request preparation for firing at two targets.

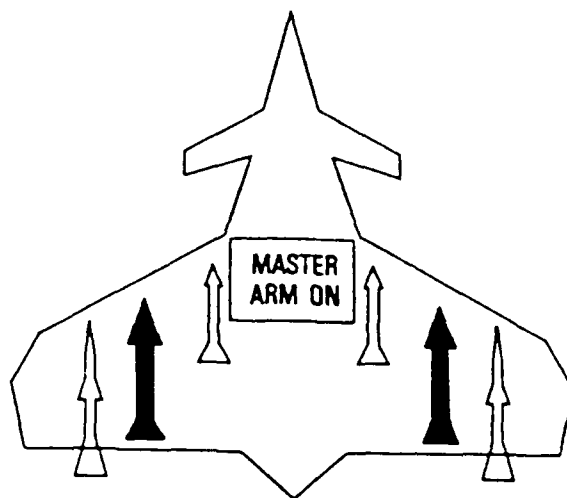
**Voice response from aircraft after command:**

"Master arm on, radar locked, in range, optimum 5 seconds."

Display at start



Display at finish



#### Situation 5.2.4

**Description:**

The aircraft advises when optimum launch range is reached. Lead and wingman fire two missiles each and disengage, covering egress with chaff and flares.

Voice from aircraft before command:

None.

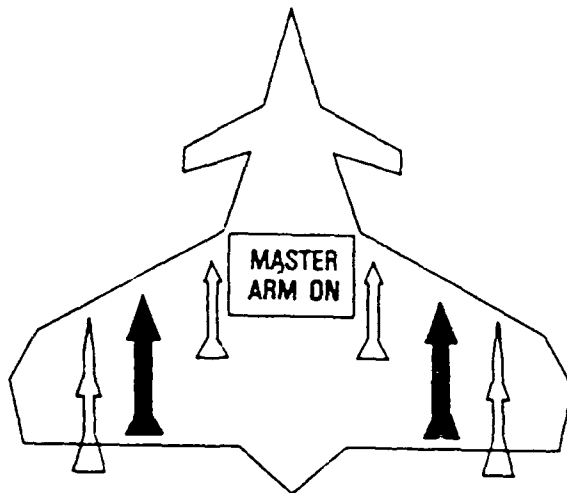
Experimenter's prompt for command:

Request chaff and flares.

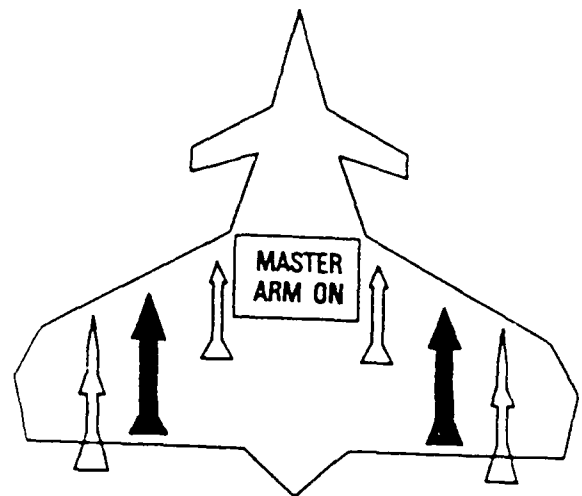
Voice response from aircraft after command:

"Dispensed chaff and flares."

Display at start



Display at finish



### Situation 5.3.1

**Description:**

The targets have been destroyed and no new threats have been detected. It is time to rejoin.

**Voice from aircraft before command:**

None.

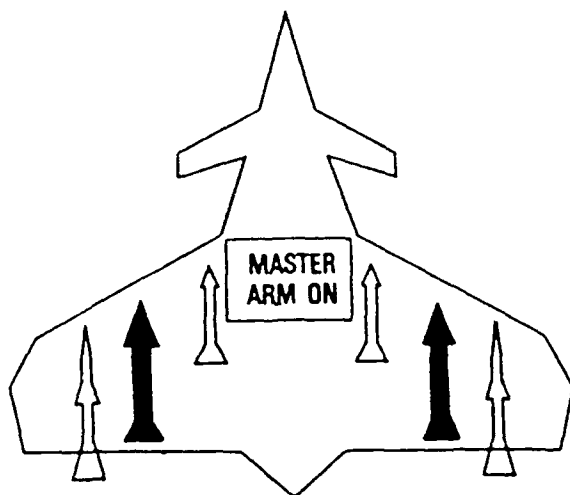
**Experimenter's prompt for command:**

Request join up information.

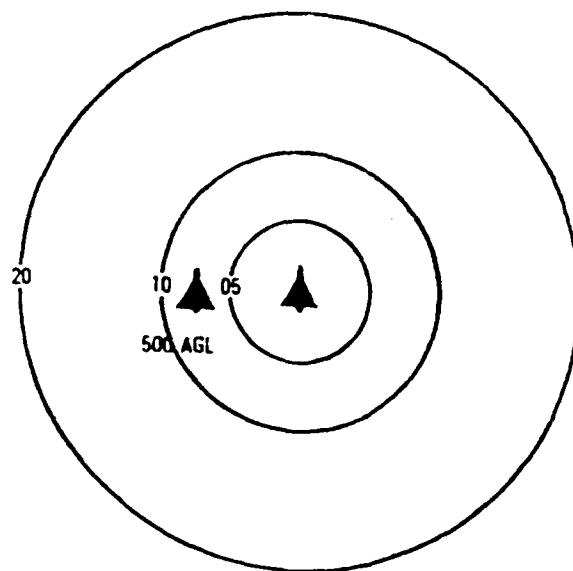
**Voice response from aircraft after command:**

"Wingman at 9:00 o'clock, 8 miles, line abreast."

Display at start



Display at finish



### Situation 6.1.1

**Description:**

Rejoin is complete. Battle assessment is to be accomplished.

Voice from aircraft before command:

None.

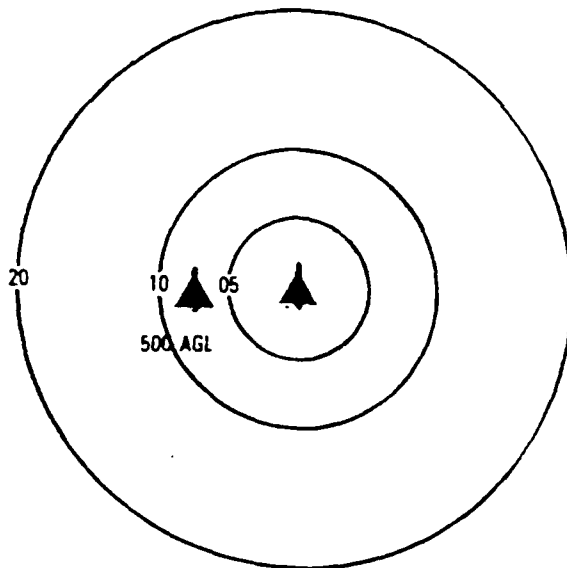
Experimenter's prompt for command:

Request system status report.

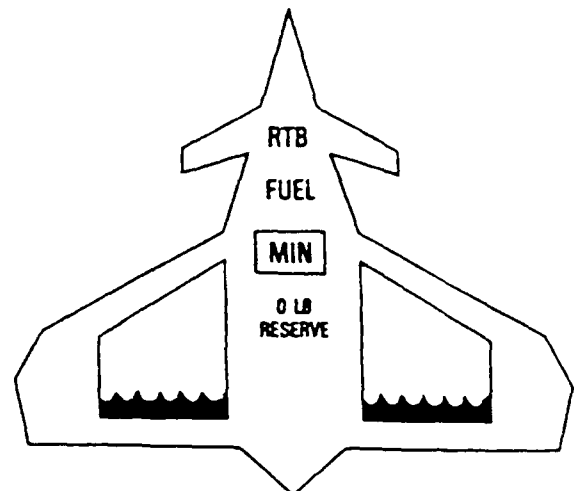
Voice response from aircraft after command:

"Minimum RTB fuel; recover at alternate."

Display at start



Display at finish



RECOVER AT ALTERNATE BASE



### Situation 6.1.3

**Description:**

The aircraft advises there are reachable alternate recovery bases.

Voice from aircraft before command:

None.

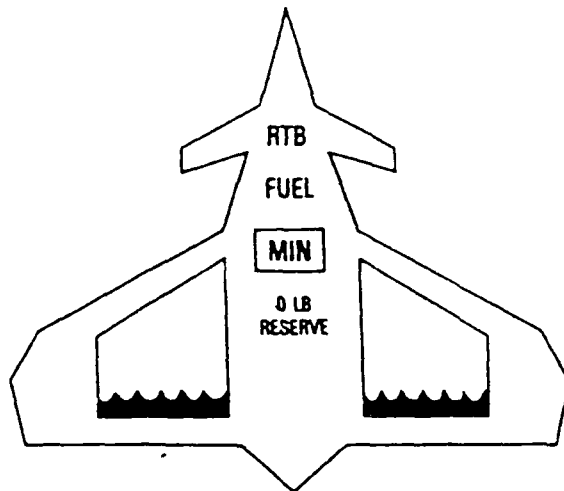
Experimenter's prompt for command:

Request display of alternate bases.

Voice response from aircraft after command:

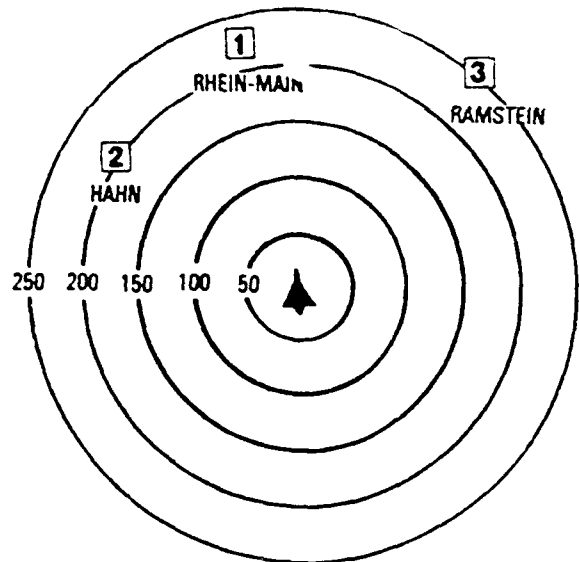
None.

Display at start



RECOVER AT ALTERNATE BASE

Display at finish



### Situation 6.1.5

Description:

Map of alternate bases is displayed.

Voice from aircraft before command:

None.

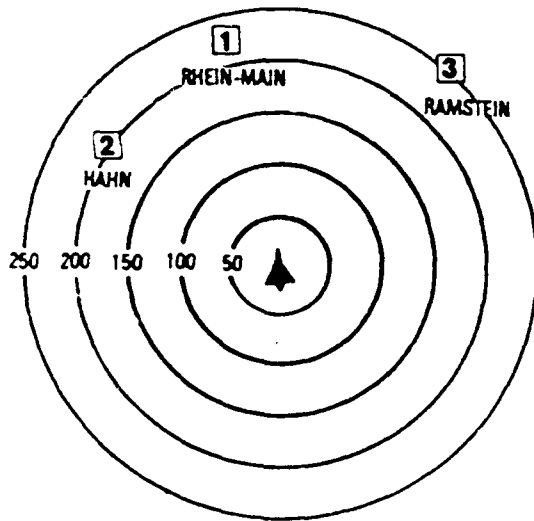
Experimenter's prompt for command:

Select an alternate base.

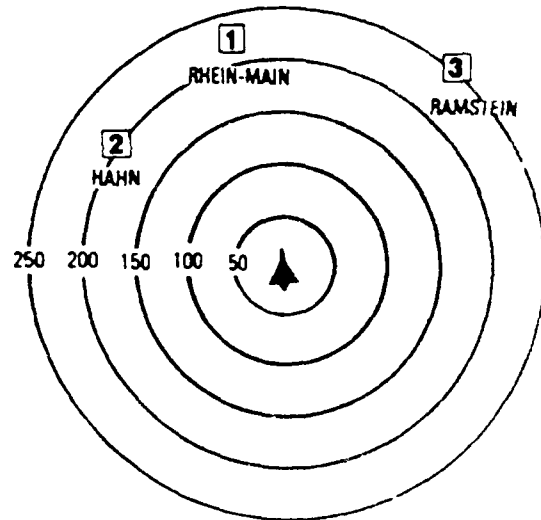
Voice response from aircraft after command:

"Message sent."

Display at start



Display at finish



## APPENDIX B

### Glossary

4v4	Four friendlies versus four hostiles.
757	Boeing commercial jetliner, 1980's production.
A-4	Navy attack jet.
A-7	single-seat USAF attack aircraft, 1960s production; primary mission is bomb delivery.
AAA	Anti-Aircraft Artillery (ground-based).
ACM	Air Combat Maneuvering.
ACMI	ACM Instrumentation; pods mounted on aircraft transmitting data to ground sites that record and display relative or absolute aircraft positions.
ADI	Attitude Direction Indicator; artificial horizon.
AFHRL	Air Force Human Research Laboratory.
AGL	Above Ground Level.
AI	Airborne Intercept.
AIM	Air Intercept Missile; types are AIM-9, AIM-9L, AIM-7, etc.
ALOW	Altitude LOW warning for terrain following flight.
AMRAAM	Advanced Medium Range Air-to-Air Missile.
AMRL	Aerospace Medical Research Laboratory.
ARM	Anti-Radiation Missile used to destroy radar-guided SAM sites.
ATF	Advanced Tactical Fighter. USAF fighter planned for 1990's production.
AWACS	Airborne Warning and Control System aircraft capable of doing GCI-type control (see GCI below).
BIT	Built-In Test.
B-scope	type of radar display.

BVR	Beyond Visual Range.
bandit	hostile aircraft.
beam	sideways aspect as in "turn to the beam;" or approach from the side as in "beam him."
bingo	amount of reserve fuel or countermeasures to get home safely.
bitching betty	cockpit voice synthesizer for caution/warning/ advisory messages to pilot.
bogey	aircraft of unknown identity.
bug-out	see egress.
C-131	USAF propeller-driven cargo plane, vintage 1950.
C3	Command, Control and Communications.
CATA	Collision Antenna Train Angle (for explanation, see subject 51 transcript, situation 3.2.5, page 199).
CAP	Combat Air Patrol; fighter mission of clearing a volume of airspace of hostile aircraft.
CM	Counter Measures.
CRT	Cathode Ray Tube; display device like TV screen.
DLZ	Dynamic Launch Zone of missile.
deuce	see F-102.
ECM	Electronic Counter Measures to jam enemy radar.
ETA	Estimated Time of Arrival.
eagle	nickname for the F-15.
egress	course outbound from target or enemy area.
F-4	two-seat USAF fighter, 1960s production; mission is air-to-ground or air-to-air; backseater is WSO.
F-15	single-seat USAF fighter, 1970s-1980s production; primary mission is air-to-air combat.
F-16	single-seat USAF fighter, 1970s-1980s production; primary mission is air-to-ground bomb delivery.

F-20	single-seat Northrop fighter, 1980's production; not purchased by USAF.
F-100	single-seat USAF fighter, 1950's-1960's production; had air-to-ground mission.
F-101	two-seat USAF fighter, 1950's-1960's production; primary mission was air defense intercept; back-seater is WSO.
F-102	single-seat USAF interceptor; same vintage as F-101.
F-111	two-seat, side-by-side, sweepable-wing, USAF fighter, 1970's production; primary mission is bomb delivery. WSO sits in right seat.
FEBA	Forward Edge of the Battle Area; dividing line between good guys and bad guys.
feet wet	ejection over water results in getting "feet wet."
fence	synonym of FEBA; used as "fence check" meaning prepare for entry into enemy area.
GCI	Ground Controlled Intercept. Ground-based radar directs interceptor aircraft to target aircraft.
GPS	Global Positioning Satellite.
HARM	High-speed ARM.
HOTAS	Hands On Throttle And Stick; term for cockpit control switches with immediate pilot access.
HSD	Horizontal Situation Display.
HUD	Head-Up Display. Cockpit display projected on the section of the canopy in front of the pilot.
heater	heat-seeking, infrared missile.
Hind	NATO designation for a specific Soviet helicopter.
hold down	direction finding using communication radio modes.
ID	Identification; Identify.
IFF	Identification Friend or Foe.
IFR	Instrument Flight Rules means flying in clouds that obscure view of the horizon.

ILS	Instrument Landing System.
INS	Inertial Navigation System.
IP	Initial Point; navigation point just before target.
IR	Infra-Red.
IRST	Infra-Red Search and Track sensor or display.
ingress	course into target or enemy area.
J band	specific radar frequency.
JTIDS	Joint Tactical Information Display System; information from surface and airborne friendlies transmitted to any interested friendly entity.
joker	fuel buffer above bingo used to ensure formation rejoin, turn and climb to head home by bingo.
LPI	Low Probability of Intercept; short duration radar emissions.
lock	radar focus on target for subsequent missile launch.
MFD	Multi-Function Display.
MIG-39	Hypothetical, futuristic Soviet fighter.
MLS	Microwave Landing System.
master arm	mechanical cockpit switch for activating weapons before firing.
mudders	fighters with air-to-ground mission.
mud slingers	same as mudders.
NA	Not Applicable.
NATO	North Atlantic Treaty Organization.
nav	navigation or navigator.
PA	Pilot's Associate; artificially intelligent pilot aide under preliminary development by USAF.
PK	Probability of Kill.

PS	Probability of Survival.
package	formation of escort fighters and attack flight together.
popeye	in the weather; not VMC/VFR.
QC	Quality Control.
RF	Radio Frequency energy.
RHAW	Radar Homing And Warning; onboard system for detecting enemy radar.
Rmax	MAXimum Range missile launch.
ROE	Rules Of Engagement.
RTB	Return To Base.
RWR	Radar Warning Receiver; same as RHAW.
SA	Situation Awareness.
SAC	Strategic Air Command; branch of the Air Force responsible for strategic bombing and reconnaissance, aerial refueling, and strategic missiles.
SAM	Surface-to-Air Missile designated SA-10, SA-18, etc.
SCP	Set Clearance Plane; desired altitude AGL.
SPO	System Program Office; USAF office responsible for weapon system development.
strikers	attackers; same as mudders.
squawk	IFF on.
T-2	Navy trainer.
T-33	two-seat, tandem, subsonic trainer; was used in USAF pilot training; Korean War vintage.
T-34	Navy jet trainer.
T-37	two-seat, side-by-side, aerobatic, subsonic trainer; first jet flown in USAF pilot training.
T-38	two-seat, tandem, supersonic trainer; second jet flown in USAF pilot training.

T-39	commuter-size USAF jet used as a business jet.
TACAN	TACTical Air Navigation; navigation radio used by USAF giving bearing and distance from one station.
TD	Target Designator.
TF/TA	Terrain Following/Terrain Avoidance; low level flying.
TOT	Time On (or Over) Target.
TWS	Track While Scan radar mode.
tally	short for tallyho (see below).
tallyho	Visual sighting of object of interest (e.g., target, wingman, missile).
threat	ground-based hostile weapon system (e.g., SAM).
triple A	see AAA.
Vc	Closure Velocity (pronounced "v sub c").
VD	Vertical Display.
VFR	Visual Flight Rules (used like VMC).
VMC	Visual Meteorological Conditions; horizon visible.
VSD	Vertical Situation Display.
WSO	Weapons System Officer; rated navigator whose primary duties are to operate the radar and calculate bomb delivery geometry.
weasel	fighter mission of baiting enemy SAM sights to go active so they can be located and destroyed.



## APPENDIX C

### SUBJECT 43 - Biographical Data Form

Age (Years): 41  
Organization: Veda, Inc.  
Full time/Part time: Not Applicable  
Occupation: Engineer  
Squadron position: Not Applicable  
Total flying hours: 3,500  
Total jet hours: 3,100  
Total years rated: 12

Specific Aircraft (type, hours): F-15, 1100  
T-39, 1800  
F-4, 200  
T-37, 100  
T-38, 100  
C-131, 250

SUBJECT 43 - TRANSCRIPT

s 1.2.2

e Throughout the scenario, you might want to do something  
e different from what we planned, which is okay; but, then we  
e have to return to the way we planned it in the scenario  
e because we don't have unlimited flexibility, okay?

p Okay.

e First thing we want you to do is react to the situation in  
e your terms. What are you thinking about? How are you  
e dealing with the information we're feeding you? What pieces  
e are you putting together to get situation awareness? And we  
e want a voice command from you in those terms. What you  
e would want to say to the crew station, to do whatever you  
e want to do. If it does not match with the mission scenario  
e (an "o" other command), that's fine. I mean, we can't guess  
e what each of 60 pilots, what everyone's going to do,  
e necessarily. So we get your intentions, thoughts and  
e commands, and then we ask you to come back into our scenario  
e and give us a voice command based upon it (a "c" command).

p Right.

e We only have a single display capability; but if you feel  
e like you should have other displays up, you might mention  
e what those displays are for. If you feel those are  
e inappropriate displays at any point in time, then we can  
e address that, too.

p Okay.

e Do you have any questions at this point?

p No.

e Then I want to go briefly through the scenario that you'll  
e be flying.

p Okay.

e You're in a flight of two advanced fighters, flying a  
e prestrike sweep. You're going to rendezvous with two strike  
e aircraft. The attack aircraft are responsible for attacking  
e the airfield and are configured with stores for this role.  
e Your fighters are assigned to clear the area of airborne  
e threats. Now you're configured with air intercept missiles,  
e long and short range, and guns, and also anti-radiation  
e missiles for the SAM sites. You're the lead fighter in the  
e scenario.

p Okay.

e And based on assessment of the overall tactical situation,  
e you elected to keep the flights low during the initial  
e penetration. The attack and fighter aircraft are flying  
e separately in twoship formations and will rendezvous just  
e before crossing the forward edge of the battle area.

p Good.

e After the rendezvous, the fighters and attack aircraft will  
e descend to two hundred feet, cross the FEBA, and fly down a  
e heavily defended valley.

p Okay.

e Your fighters will be in trail formation two miles apart.  
e And the attack aircraft, also in twoship formation, will  
e follow you by about five miles. Before reaching the target  
e area, your fighters are assigned to intercept an enemy  
e combat air patrol that poses a long-range threat to the  
e strike. As the fighters climb out to begin the beyond-  
e visual-range intercept, they receive sensor and data-link  
e reports concerning several groups of aircraft operating  
e within a two hundred nautical mile radius of their location.  
e You then attack these aircraft, fire your long AIM's, and  
e turn to escape. And the strike aircraft deliver their  
e weapons on the target.  
p Okay, so, basically, it's a close escort mission into the  
p target area?  
e Right.  
p Once they hit IP, I can break off? Or just prior to IP, I  
p break off? For the intercept on the threats?  
e Yeah, the reason we have to do that is because we're trying  
e to collect a range of vocabulary to include air-to-air.  
p Okay.  
e So the range may throw you off a little bit at that point,  
e but bear with us.  
p Okay.  
e So we're ready to start the mission, then, unless you have  
e any questions.  
p One. Am I leading or trailing the other formation?  
e You're leading.  
p I'm leading the ground attack flight in?  
e Once you link up, they're behind you.  
p Okay.  
e The mission begins, then, with your twoship of fighter  
e aircraft descending through 5000 feet and 0.85 Mach in  
e instrument conditions. Your wingman is in trail, maintaining  
e his position via data-linked information between aircraft.  
e You as flight lead are responsible for accomplishing the  
e preplanned rendezvous with the two attack aircraft, which  
e are also aware of your position via data-link.  
p Okay.  
e And this is what the aircraft has displayed at this time:  
e You just crossed waypoint two. Here's your ownship. Here's  
e your wingman behind you.  
p Okay, I'm descending through 5000 at 0.85, instrument  
p conditions?  
e Yeah. Okay, then your aircraft reports updated rendezvous  
e information:  
v Rendezvous data.  
e And that's what your aircraft tells you. So, at 1.2.2,  
e describe your concerns and intentions at this point.  
p Okay. I want to know:  
c Show me attack flight.  
o Show me ground map.  
p Those are the two most important things to me right now if

p I'm descending in the weather into the valley.  
p And I want to know where the other flight is, so I can time  
p the rendezvous.  
e So, then, could we get you to rate it there?  
p Oh, sure.  
e Voice compared to usual methods.  
p Okay, speed. Workload. Usefulness, okay. It was good.  
p What's the conflict? That one may be....  
e If you were trying to talk to other people in the environ-  
e ment, and other people were talking to you, voice may be a  
e conflict.  
p Some other type of communication? Okay. No, that shouldn't  
p be a big problem.  
e Okay, you asked for information, and you get:  
v Sabre 41 at 14 miles closing.  
e That's your attack aircraft, coming in to meet you.  
p Okay.

s 1.3.2  
e Okay, at this point in the mission, you are approaching  
e rendezvous. And your aircraft has received a data-linked  
e message concerning the discovery of new threats down range.  
e Threat information has come from satellite and JTIDS  
e sources.  
v Threat data.  
e Specifically a new ground-to-air threat, twenty miles ahead  
e on your flight path. The aural cue "Threat data" advises  
e you that the new threat is appearing and more information is  
e available upon request. Okay, at this point what are your  
e situational concerns and intentions?  
p I want:  
o SAM engagement zone.  
e And what is that? What kind of information do you need?  
p What I want at that point is a display in relationship to me  
p that shows his area of possible engagement on me, assuming I  
p continue present course.  
e Okay.  
e How would you ask for that?  
o SAM zone.  
e Could you rate...?  
p Sure. Speed should be good. Conflict should be good, I  
p would think, unless these guys are trying to call me.  
p Workload.... Very good on usefulness, as far as this SAM  
p information is concerned.  
e Okay, we don't have the zones on there. But this is what it  
e tells you when you ask for detailed information:  
v Tracking J band.  
e Tells us that it's tracking.

s 1.4.1  
e Okay, the threat is real and must be dealt with. But you  
e would like to maintain heading until after rendezvous, if

e possible. Okay, describe your situation and concerns at  
e this point. You know that it is a real threat.  
p Okay, I want to know what countermeasures are available.  
p And, in fact, I want to know if they're up, too. So I'd  
p ask:  
c Are countermeasures up?  
e Okay, anything else?  
p No, that's good right now. Very good. Conflict should be  
p no problem. Workload, good. Right now, I'm trying to  
p interpret all that myself. And usefulness, very good.  
e Okay, here's what the aircraft gives you: your ECM is in  
e standby; and you have chaff, single, 90 bundles; and flares.

s 1.4.3  
e Okay, with this information, what would you do next?  
p I would want the ECM brought up full. And I'd give it a  
p command:  
c Buzzers on.  
e Which would do what?  
p Turn that dude on.  
e Okay.  
c Buzzers on.  
c Arm expendables.  
e Could you rate that, down here?  
p Conflict's about the same as current ways of doing things.  
p Workload...that's good. Okay.  
e And your aircraft reports:  
v ECM and chaff selected; threat no factor.  
p Continue to monitor...I'd just say:  
o Monitor.  
e The thing's smart enough to know there's an SA-10 there, so  
e it did whatever it took to counter an SA-10.  
p Okay, flares and/or chaff, too?  
e If you wouldn't want it to happen automatically, then we  
e need to know that, too.  
p I'd prefer it to say, "Flares and chaff available. ECM is  
p effective." I want to do my own expendables.  
e Okay.

s 1.5.2  
e The threat is no longer tracking your flight as you approach  
e the rendezvous. And the aircraft reports:  
v Rendezvous data.  
e At this point what are your concerns and intentions? The  
e aircraft just told you it's got rendezvous data.  
p I'd want an expanded display, which shows me the  
p relationship of my flight with the other.  
e Okay. What would you say to get that?  
c Expand the Gods-eye.  
e Okay. Could you rate that there, then, please?  
p Uh huh. Conflict...potential.... Workload's probably about  
p the same in this particular case, considering I could bring

p up the radar scope, or whatever. Usefulness.... Okay.  
e You'd have the Gods-eye up all the time, probably.  
p Yeah.  
e Okay, it displays the other flight's location, speed and  
e altitude.  
p Alright.

s 1.5.5  
e Now, the rendezvous is complete. And your flight is  
e escorting the attackers towards the FEBA. As you approach  
e within 25 miles, your onboard system cues:  
v Consent for fence check.  
e The aircraft waits for your consent to automatically  
e accomplish all the appropriate actions. What are your  
e concerns and intentions at this point?  
p My concern is to make sure everything's armed up at this  
p point and that everybody else is armed as well. And I'd  
p just call for:  
c Fence check in.  
o Check wingmen armed.  
e Okay. Would you rate that? We're assuming that you had the  
e system...before you took off, you had everything in that you  
e wanted to...  
p Program, yeah.  
v Fence check complete.  
e What would you want done for the fence check?  
p Fence check inbound, I want: check master arm on; all  
p weapons armed; ECM in standby, ready to come-on; check  
p lights out, which is basically external lights; and min  
p emissions, which means basically anything I don't need for  
p this particular segment of the mission I want in standby  
p mode, not emitting.  
e Alright.

s 1.6.1  
e Now you are initiating a transition to low-level operation,  
e 500 knots, 200 feet. Your aircraft has full TF capability.  
e You need only select values, modes, and check equipment  
e status. How would you request this to come up?  
p Okay, values, modes, and check....  
o Weapon system status.  
e Okay. Assume your weapons are okay.  
p Oh, assuming weapons okay.... I'd just ask for:  
c TFR.  
e Low probability of intercept. Set clearance plane.  
e Altitude low warning, 100 feet. Do you want that? Or do  
e you want it by exception?  
p Hmm. That...  
o Fence check LPI.  
p Would be fun. That could be automatic. Set clearance plane  
p at 200 or 100, that could be pre-mission programmed. That'd  
p be fun. It could be automatic. You know, then I could

p override if I wanted something different. If I want to take  
p it down to 100 and set 50 for warning.  
e Okay. Then, could you rate that there at 1.6.1?  
p Okay. That looks good.

s 1.6.3  
e Okay, now that you have this, we want you to select one of  
e the modes. What kind of a command would you do to select...  
p One of these modes?  
e Yeah, manual or auto?  
c Auto on.  
e And if you go ahead and rate that, that's basically all  
e we're doing there is:  
v Auto.  
p Alright.

s 2.1.2  
e Low-level transition has been completed. You're proceeding  
e at 200 feet AGL on course. Current threats are on the  
e horizontal situation display. And, then:  
v Threat data.  
e What are your concerns and intentions at this point?  
p Okay, my concerns are, assuming we're out of range of the  
p AAA, is:  
c Hostile ID.  
p On the target at twenty.  
e What kind of information do you want to see with that?  
p I want type aircraft. I'd like that to be automatic, if I'm  
p going to see red. The ID systems are up and on-line; I  
p want it to give me the information right with the display.  
e Would you want that visually, aurally, or both?  
p Visual. And I want it to stay with the display so I can  
p continue to monitor. Flash it...  
e Until you've acknowledged it's there?  
p Yeah, if I'm looking at an attack display and if my  
p attention is probably on this thing right now, okay, I'll  
p see it. So, for the first two or three seconds, when it  
p first comes on the screen, flash it. Then stop flashing.  
e You wouldn't want any aural indication that....  
p Maybe aural similar to what we get off our RWR today. An  
p initial beep, just to cue me that there's something to look  
p at, if I do happen to have my eyes somewhere else.  
c Hostile ID.  
e And then here's what it gives you:  
v Helicopter eighteen miles, twelve o'clock low, closing.  
p Okay.

s 2.1.4  
e Consider this a viable threat, like a Blue Thunder type  
e helicopter that has missiles. It can get you. And you have  
e to deal with it.  
p Okay. Again:

o Aircraft threat zone.  
p And that's how I'd ask for it...or:  
o Hostile threat zone.  
p This is going to be hard. You have to work up a whole  
p terminology. Everything's hostile. I want to know the  
p range of his effectiveness. I want you to show me a weapons  
p envelope drawn from his airplane, extending out from his  
p airplane. If I fly into that zone, he can take me out.  
e We work with those displays alot; they're very difficult.  
e What about escape/no-escape cues, maybe, a red/yellow zone?  
p Yeah, something like that. That'd be fine.  
e Yes, air-to-air is hard to display on a two-dimensional  
e surface...probably not going to be efficient, in any form.  
p Yeah, only at long ranges. You're right.  
e Okay, could we get you to rate that?  
p Okay. Usefulness....  
e Also, could I get you to give a command, then, to request  
e your long AIM? That's to follow the scenario.  
c Target radar.  
v Master arm on.  
p Okay. And I know I'm up green. And I got one standing by.  
e Right.

s 2.1.6  
e Again, what would your concerns and intentions be now?  
p Same. Okay. Let me think about something here. I've got  
p an airplane that is also doing HARMs. I'd want the air  
p attack display, which is basically what I'm telling you, is  
p to change my HUD from ground attack to air attack mode.  
e How would you ask for that?  
p I would want it automatic, with the missile coming up. If I  
p made that decision and told you:  
c Radar target.  
p or  
c Target radar.  
p Then, I know I'm going to go with the long range.  
e Okay.  
p And I might change command, depending on whatever technology  
p I've got hanging on the wings. If it were specifically an  
p AMRAAM, for example, I'd say:  
c Target AMRAAM.  
p or  
c Sparrow.  
p or  
c Winder.  
e You'd use the name....  
p Yeah, I'd use the name of the missile. I wouldn't want to  
p confuse the system. I think speed's about the same here,  
p because I've got the weapons capability on the airplane.  
p Which is probably just as fast as talking to it.  
e You're talking about the dog fight switch?  
p Yeah, dog fight selection.



e As opposed to the F-4 where you flick switches and turn...  
p Turn the wafer switch. Flip on 3 switches. And then, pray.  
p Yeah, but you didn't forget how to do it. Yes, definitely.  
p Conflict: there wouldn't be any problem there. Workload:  
p about the same. Usefulness: probably about the same in this  
p case.  
e Okay, with what you selected there, you get:  
v Radar locked, in range, optimum five seconds.  
e It's telling you when you have an optimum point to fire. Is  
e that useful information?  
p Yeah, because it gives me some idea of the time lapse that I  
p have to work with. So it helps me pace a workload at this  
p point in the cockpit.

s 2.2.2  
e Okay, so you fire the missile. The helicopter goes down in  
e flames. And you proceed on course through a mountain valley  
e approaching a lake. Your formation is still intact. You  
e realize the explosion will now highlight your presence. A  
e few seconds later the aircraft reports:  
v Threat data.  
e Reports a new SAM-18 threat, at twelve o'clock.  
p Okay.  
e Okay, what are your concerns and intentions at this point?  
p Again, I want:  
c SAM engagement zone.  
e Okay, is that how you would request details on the SAM?  
p Yeah.  
c Show me SAM engagement zone.  
p or  
c Show me SAM zone.  
e Alright. So that's for 2.2.2.  
p Speed: very good. Conflict.... Workload.... Usefulness,  
p definitely. Anything that keeps me alive is very good.  
e Okay.  
v ECM ineffective, reroute available.  
e Here he's telling you he's got a new route you can take, and  
e your ECM isn't going to....  
p Isn't going to work?  
e Right.

s 2.2.4  
p Okay.  
c Alternate routes.  
e That's what we're looking for. Could you rate that?  
p Okay.  
e Do you have any other comments at that point? What if a  
e system could do alternate routes for you; what parameters  
e would you rate to do those? Like fuel?  
p Yeah, fuel, time, other threats.... I'm trying to think.  
p Generically, I can't imagine that, given no threats, that  
p one is particularly any better than the other, other than in

p regard to those two type things. I'm concerned about fuel  
p and time I spend in the area. You know, total time of  
p exposure. Prior to target. And then, obviously, other  
p threats in relation to that if it picks anything else up.  
e Okay.

p And then I'd just ask for:

c Best route.

e Alright. Here's what the aircraft gives you. Telling you  
e that you need to accelerate to 510 knots to keep your time  
e on target.

p Yeah, maintain the time?

e And the yellow means we haven't selected it, yet. Here's  
e the route you're currently on; and here's the one you can  
e select, if you choose to.

s 2.2.6

c New route.

p Is what I'd command.

e Okay, for 2.2.6, how would you pass that to your wingman?

e Or, would you want it to automatically go to him? Or would  
e you have some command to have it data-linked to him? See,  
e we're assuming that the information will be data-linked to  
e him, once you select it, since you're the lead.

p I'd want that to be automatic. I would want the PA, or  
p whatever, to know what my course, heading, altitude, air  
p speed, all that sort of thing, is supposed to be in  
p relationship to this route segment. If I varied from that,  
p data-link that automatically to the wingmen, so they know.  
e Well, we can still say if it wasn't automatic, how would you  
e ask for it?

c New route transmit.

v Message sent.

e It did it for you.

s 3.1.2

e You are proceeding on the rerouted segment of the low level  
e approach at 200 feet AGL, when your aircraft reports from a  
e JTIDS update that a new air threat now exists. You have  
e requested additional threat information. The horizontal  
e situation display has automatically changed scale. And the  
e threat aircraft are identified with location, direction,  
e speed, and altitude. Your aircraft is still set up for  
e countering low altitude threats.

p Yellows are bogeys, I assume. Unidentified.

e Right. What are your concerns and intentions at this point?

p I want to know, once again:

o Attempt ID.

p That's the first thing I need to know.

e We're requesting that you reconfigure your aircraft for an  
e air-to-air BVR.

p I'm still set up for countering low altitude threats, so I  
p won't get....

e What kind of command would you give, to do that?  
c Long range attack.  
v Configured air-to-air.  
e If you say that, do you like that coming back, telling you  
e that? Or do that as a display?  
p Probably rather have it in the display.  
e Do you like so much chatter coming back to you?  
p No. I'd just as soon have it up here in the top corner or  
p whatever. Just show me "A/A" or "A/G" for air-to-ground.  
e You don't like the verbal acknowledgement also?  
p In this particular case, it doesn't add anything. It's just  
p as quick because I've got my attention here on it now. I'll  
p see it pop or change.  
e Alright.  
p Yeah, speed wise, it's the same. Conflict.... Workload....  
p I don't think it adds or detracts, either way. The same for  
p usefulness.

s 3.1.4

e How would you request, at this point, a setup of long air  
e intercept missile?  
p Okay:  
c Arm AMRAAM.  
p or  
c AMRAAMs up.  
p That'd be good.  
e Okay.  
v Master arm on.  
e What are your concerns, intentions at this point? You  
e selected your missiles. You know they're out there 200  
e miles.  
p Okay.  
o Intercept path.  
p Just going to map out the ground run. Might as well give me  
p a mapping for the best attack path at this point, too.

s 3.1.6

e We have an infrared search and track sensor on the aircraft.  
p Okay.  
e How would you request that display to come up?  
c Heat track on.  
e Here's what the aircraft displays when you call for that.  
p Is this like a radar scope?  
e Yes.  
p Okay. So, showing position off nose....  
e This is one of those displays we left in because it is  
e representative of conventional displays. But, I don't think  
e it's intuitive at all. How would you change it? Not to  
e lead you, but for instance other people have said it would  
e be more appropriate on a ring display.  
p A round type? More like a JTIDS type? Yes, it would.  
p They're correct on that. God's-eye view's okay, for this

p point in time. I'm going to want to transition this thing  
p to three-dimensional, for entering the attack phase.  
e Okay, good.

s 3.2.1

e We want you to request detailed information about these....

p Okay.

e It's something that you expressed earlier.

c ID.

p Yeah. I still want an ID on them, as soon as I can get it.

c Continue ID.

p You know, I may not be within range right now, but continue  
p attempting to give me an ID on them.

e Alright. Rate that, please.

p Alright. Very good usefulness....

v Hostile.

e It's finally determined that they are hostile aircraft. And  
e it shows them in red.

p Okay. Next question's going to be:  
o type aircraft?

e Okay, that's fine. Any other concerns or intentions?

p No, the main thing right now is I want to start formulating  
p a battle plan. So I want to know whether I'm looking at  
p bombers or fighters, and what their capability might be. As  
p soon as I know type aircraft I'll be able to start thinking.  
e Suppose you could have some information on threat zones at  
e this point, is that valuable information to have?

p That far out, probably not. Not until we get way down the  
p road, unless we're looking at 200-mile missiles.

s 3.2.3

e Okay, what we want you to do is request a close-up view.

e Say, it can zoom in and see them closer.

p Oh, okay.

e What kind of a command would you give to....

c Formation breakout.

e Alright, could you rate that?

p Okay. Workload.... Okay, very good.

e And it gives you a zoomed-in view.

p Okay.

s 3.2.5

e What are your concerns and intentions now that you see a  
e zoomed-in view? I guess you're still wanting ID, since....

p Yeah, I'm still wanting ID. But I've already told him to  
p continue ID. So I assume he's going to continue to do that.  
p I won't regive that command.

e Okay.

p Okay. At this point I go back to:

o Long range.

p Which means I want the display back from before, now that I  
p have an idea that the formation looks that way.

e Okay. We have something built-in so that you can request a  
e track analysis. Based on their current speed and direction,  
e where they will be in a certain amount of time, okay?  
p Oh, okay.  
e How would you request that if you have that capability?  
p Never having had that kind of capability before....  
e Would that be useful?  
p Yeah, it would be. Yeah, definitely.  
c Track path.  
e Okay.  
e If you had that capability, would you want it to be, like,  
e for a certain period of time, or automatic, or what?  
p This one I almost have to sit and explain because I can tell  
p you what I don't like in an airplane today, and what's wrong  
p with it. What I get today, of course, is the little dots,  
p like so, on the radar scope, right?  
e Okay.  
p If I read all the numbers around the scope, I can figure out  
p what direction he's heading, and the whole nine yards. But  
p what I don't have today is what a JTIDS display would show  
p me: Which end of his airplane is pointing where with a  
p speed vector out the front of his nose, which gives me some  
p idea of direction. It's much better than reading numbers.  
p It's a much easier interpreted display.  
e Okay. That's just about what we will give you I think.  
e Could you rate that? Then we'll show you what happens.  
p Alright. Workload's same as it would be if I had switches  
p to do that with.  
e Okay.  
v In range for air-to-air radar.  
p OK, it showed me they are definitely coming in my direction.  
p They're going to cross my flight path and extend it.

s 3.2.7

e Now that you know that, what are your concerns and  
e intentions?  
p This is about the point I want to start transition into  
p cockpit view. Then if they're starting to be in range...  
p Now, how am I going to ask for it? I'd call for:  
o Three D up.  
e Okay, that's what you mean by cockpit view? You want a 3D  
e look at what's going on?  
p Yeah.  
p Ever see an ACMI or an ACMI tape replayed? When they display  
p a cockpit view from aircraft number two, that's the same  
p type of thing I'd like to see.  
e I've seen one of those out at Holloman.  
p Okay, because even if the airplanes are 100 miles away, what  
p you still see on the display is the correct position of them  
p in relationship to your aircraft, with the canopy bow and  
p everything else. And it shows little dots, up there.  
e Do you have that in the aircraft now?

p No. No, this is just an ACMI replay of the data inputs from  
p the pod transmissions.  
e Okay, what we want you to do, though, is request an air-to-  
e air radar, at this point.  
p Oh, okay.  
c Air attack up.  
e Okay. Have you ever worked with a back seater?  
p Yes. Oh, I hated it. Yeah, it's very difficult to  
p communicate, unless you.... You almost have to eat, breathe,  
p and sleep together for about nine years. Probably one of  
p the problems was we didn't have any F-4 program. We never  
p really had a backseater for any length of time. You know,  
p we didn't come in the squadron and have the same backseater  
p for three years, or that sort of thing. Like SAC does, when  
p they put an integrated crew together. In terms of speed,  
p I'm going to have to say it's about the same because I could  
p have a throttle switch. Conflict...about the same.  
p Usefulness is good. Okay.  
e Okay, the display shows your radar in track-while-scan mode,  
e tracking four ships. It estimates their type as MIG-39.

s 3.2.9  
e And your onboard air battle management system has computed  
e optimal intercept profiles. These intercept options are  
e available upon request. You had asked for them earlier.  
p Okay.  
e What are your concerns and intentions?  
p In TWS, we're tracking four estimated MIG-39's; my concern:  
o Monitor threat zone.  
p And now I want:  
c Attack path.  
e Meaning your attack path, right?  
p My attack path to them, right. Which means I also expect it  
p to monitor the threat zone. I would like it to take that  
p into consideration when it gives me an attack path.  
e Could you rate that, there, then? Okay, your aircraft  
e displays two possible attack options, 1 and 2. Intercept  
e option 1, due to its priority number, has a shorter time to  
e engage, but a lower probability of kill, about 0.5. Option  
e 2 has a PK of about 0.98.

s 3.2.11  
e So, given that information, what are your concerns and  
e intentions now?  
p Okay. No doubt about it, I'd take path two.  
e Anything else you're thinking about, or why does that appeal  
e to you?  
p Much higher PK plus conservative plus just intuition tells  
p me that putting them on the flank gives me more time to set  
p up the intercept, set up my attack, get my wingman  
p coordinated, the whole nine yards, rather than going head on  
p into the pack. And the quicker I'm getting to him, the

p quicker he's also getting to me.  
e So, how would you request a second intercept option? What  
e would you say to tell the aircraft to take that route?  
c Give me attack two.  
e Okay, then your aircraft just reconfigures and shows that  
e you took option two.

s 3.2.13

e Describe your concerns and intentions now.  
p Okay, I'm approaching a hundred miles out. I want:  
o Attack and threat displays.  
p Which, basically, means I want to look at the situation,  
p them versus me, at this point in time. Again, I'd like to  
p see some sort of a weapons envelope, from them based upon  
p what the system already knows about a MIG-39 and its onboard  
p capability. I also want to see my zone projected out there,  
p so I have some clue about how long I have. I'm going to  
p know ahead of time, when I broke off, that I've got roughly  
p so many minutes or seconds or whatever it may be to work....  
p To cut these guys off while my ground attack flight hits the  
p target. So, I may want to modify this path. For example, I  
p may fly out here so long and then make a cut directly back  
p into them, last minute, get quick missiles off, and do a  
p hard break turn to get out of there.  
e What do you think of a machine giving you tactical flight  
e path steering like that, does that go against the grain?  
p I don't think so. Not down the road, by any sense. If it  
p could assess the situation better than I can, and it  
p probably will.... Because guys get killed by the one they  
p don't know about; but the system may very well know. I  
p think you may get to the point of saturation, just from the  
p number of threats, so that you cannot afford to override the  
p system. An example: Here's a guy in an F-111, in terrain  
p following radar at night, going down a valley. He gets  
p uneasy about letting terrain following radar fly him around  
p the canyons, and takes it off and.... You know, how many  
p guys do we lose? F-111's do crash in that situation because  
p that system had a lot better SA than he did at the time. And  
p I think you're going to see the same thing, if it hasn't  
p already occurred, in the air-to-air community.  
e Okay. What we're asking you to do is request.... How would  
e you transmit that to a wingman at this point? Or would you  
e even want to do that? Before you wanted it to be automatic.  
e Again, would you want that to transmit when you select that  
e option?  
p Well, air-to-air, I'm not going to be able to do that with a  
p preplanned ground path because every option is different;  
p all these options are different. I may have briefed him,  
p "If it looks like such and such, we'll do that. If it  
p doesn't, we'll do the other." I still think about doing it  
p visually; but he's going to be flying off of me. And he'd  
p stay with me.

e When you selected that option, would you have wanted that to  
e automatically go to him? Or would you prefer.... We're  
e going to have you request to send it. Which way do you like  
e better? Would you want it automatically?  
p I guess one of the other things I probably ought to ask for  
p right now is to know:  
o Wingy's position.  
e Say it that way?  
p Yeah.  
o Where's two?  
o Show me two.  
p That sort of thing. So I know exactly where he is in  
p relation to me. Which I should automatically know. At that  
p time I'm looking for something a little more expanded than  
p this display because that scale isn't going to work. It  
p could just instantaneously pop up and give me maybe a five-  
p mile range, showing me he's at my right four for two miles,  
p or he's moving off to line abreast with me, or whatever.  
e Okay. When you're in this mode would you want an automatic  
e message to the wingman that says "Transition in effect,  
e standby for finalization?"  
p Well, again, I've probably briefed him on different attack  
p options: wall of Eagles, straight on, single side offset.  
p When my computer sees that I am obviously doing a certain  
p tactic, when I make a hard turn or whatever, it could tell  
p my wingman "Single side right." Again, I'd want it to be  
p automatic.  
e Okay. So you don't want to give a command, then?  
p Right. When this thing comes up and gives me the different  
p attack options, most of the time he's already been briefed  
p that we're going to do one of those options. And all he's  
p going to do is fly a position off of me. Now if he has the  
p capability to do that in the weather, he can maintain  
p position by internet. You know, he follows along at this  
p point in time. And he should be sharp enough to follow what  
p I'm doing, here, when I make a 45 check turn to the right.  
e Okay. Just cross that out there; don't rate that one.  
p I'll put "auto" in there.  
e That's good.  
v Message sent.  
e Just tells you that the message was sent.

s 3.2.15  
e You're committed now against the air-to-air threat. But you  
e are concerned about the attack flight and request an update  
e on their progress. What are your concerns and intentions?  
c Attack position.  
p Boy, there's got to be a better way to say that.  
e Whatever's best for you.  
p If the thing could be programmed with flight call signs  
p prior to mission, so it recognizes that word, I'd ask for:  
c Snake's position.



p What I'd like to see right now is, back to the big display,  
p show me where they are in relation to the target. Or, at  
p this point, it could automatically figure all that out and  
p just tell me how many seconds yet till they're dropping. So  
p I could time it. Have some sense of relationship there.  
e Could you rate that then?  
p ...Usefulness, yes, very good.  
e Now here's what we give you:  
v IP inbound.  
p Okay.  
e You're assured now that your responsibility is to attack the  
e air threat and allow the attack flight to initiate their  
e battle area tactics, and bomb the airfield. Suppose Sabre-  
e 41 was now targeted, after they passed that IP, or something  
e was endangering them; does that change your role or mission?  
p You're saying that my ground attack flight's been targeted?  
e Yeah, all of a sudden.  
p By the flight that I'm attacking, or not necessarily?  
e Maybe a pop-up helicopter or something.  
p No, because I'm probably committed at this point...probably  
p too far away to do anything about it. They're going to have  
p to hack this one on their own.  
e Would it help if the system could feed you some JTIDS input?  
p It would if I could do something about it, very rapidly. Let  
p me give you an example here; let's bring it back to modern  
p day: These guys are 125 miles out from me. And, let's say,  
p I'm about just like this picture shows, right up here. And  
p the attackers are just real close to bombing the target  
p right now. And they get inbound bandits over here that're  
p twice as close. You know, I'm a lot more concerned about  
p that than I am these guys here, now. I'm just forming a  
p barrier. In fact, there's no need for me to attack those  
p guys. My mission is to protect the ground strikers. There's  
p no need for me to ever fire a missile if they don't become a  
p threat to me or the attack flight. So, obviously, yes, I  
p would want to know if there's other bogeys or other hostiles  
p in the area that are closer, that might become a higher  
p priority threat. I would not want to get closed into just  
p looking at these guys, especially with that kind of range.  
p Now, on the other hand, if, all of a sudden, these guys pop  
p up out of a valley, attacking my ground strike flight, it's  
p probably too late to do anything about it. And I might as  
p well take these guys out, so that at least if the first two  
p miss over here, these guys now don't become a factor.  
e Okay. What about another air threat? How would you want a  
e system to reprioritize an air-to-air threat for you?  
p This is really a toughie, because we have discussed it.  
p There are definitely priorities. If you can put those  
p things down on a piece of paper, you can put them in a  
p computer, too. Now the question is: How much acceptance  
p will they gain from aircrew members? Will I be willing to  
p sit there, for example, and if I have a no-kidding, imminent

p threat, a missile inbound, last ditch situation.... Am I  
p willing to have the airplane take its own control and do its  
p own break turn, assuming that it knows better than I do what  
p the best option is? I personally have some reservations  
p about that because I know, given a 9g airplane, if I'm  
p concentrating on the guy 100 miles out...the next thing I  
p know I'm in the dark, passed out, because the airplane just  
p went into an instantaneous, 9g turn. You know, it's going  
p to fly itself for the next 30 seconds to a minute, while I  
p regain consciousness. Probably not acceptable. That's just  
p not going to happen. However, to have an immediate maneuver  
p cue, overriding all this.... Let's say, here I am, going  
p along, concentrating on the display; and, all of a sudden,  
p in red, Boom!, this whole damm thing gets replaced with  
p something that shows me a flight path, and maybe sets the  
p buzzer off or an aural warning. I mean, the point is, I'm  
p flying it and reacting to it; but, it gives me something  
p immediately that gets my attention, both visually and  
p aurally.  
e Do you have any thoughts about what that aural might be?  
p Yeah, I have. This will kind of be off the wall, okay.  
p But, first of all, you bring guys like myself, any guys who  
p have flown fighters, and one of our problems is we are bound  
p by what we have done for so many hours in the cockpit, that  
p we don't tend to think in large leaps. Things that might  
p stimulate me or get my attention, are okay. But when you  
p guys put this system in a real airplane, the pilots who are  
p going to be using it are the kids in the damn video arcade.  
p What we really need to do from the humans factors standpoint  
p is find out, today, what kinds of things stimulate them when  
p they play video games, or whatever. What are the cues that  
p they respond to? Because by the time that kid gets to be 22,  
p graduates from the Academy and goes to pilot training, he's  
p going to have a hell of a lot of hours playing video games.  
p And those are the type things he's going to respond to.  
p All of us in this group right here now -- I won't say you're  
p all as old as I am -- but, we grew up without video games.  
p We grew up on TV, visual and voice. And those are the type  
p things we use in the airplane today. I look around, and  
p listen to the radios; so, if my wingman says "Break right!"  
p I don't think about it; I just break. On the other hand,  
p the kids playing video games may respond a whole lot faster  
p to "beep-beep-beeps" or some cue that shows some weird  
p little flight path marker, or whatever it may be. So, I  
p think we probably need to start bringing that into it. We  
p need to look at where the kids are that are going to fly  
p these airplanes when we put them out there on the line.  
p Most of them are about junior high school, right now,  
p soaping my windows every week and throwing toilet paper in  
p the trees!  
e We addressed that one time in the lab, and I don't think  
e right now the Air Force sees much use in it.

p I would say either at AMRL or AFHRL, somebody at that level,  
p those kind of people ought to be looking at those things.  
p What are the experiences that are forming the perceptions of  
p that age group? Very honestly, I've played video games with  
p my son, who just graduated from high school. I'm terrible.  
p I really am. I can't use one of those track ball things at  
p all. That just doesn't relate; but, if somebody gave me a  
p stick that had a real sense of feel, I would love it.  
e That's interesting, yeah, that's a good point.

s 3.3.1

e How would you get an intercept vector?

p Okay, this is the point at which I'd like to see your  
p pathway-in-the-sky. And I'd like to just ask for:

c Attack path.

p And have it go now to the three-dimensional cockpit look-out  
p view, to give me a pathway to follow. You know, something  
p to fly.

e Okay, could that rate that there then?

p Okay.

v Vector zero six zero.

p Okay, like a GCI call by my pilot's associate. Geez, makes  
p it simple.

e Good.

p But the thing you have to watch out for.... I've noticed on  
p the displays and the pictures I've seen of the pathway-in-  
p the-sky, is guys concentrate on flying that pathway-in-the-  
p sky so hard, they forget what they're really out there for.  
p All the displays I've seen is it's a very predominant  
p feature. And it's so predominant that guys tend to sit  
p there, and fly the HUD. It's like instrument flight or  
p something. And you get to worry about that and you forget  
p about the four MIG's coming in. Or the fact that they're  
p shooting.

e It'd have to go into a very well integrated display set.

p Yeah. So, it gives me a vector zero six zero. That's as  
p good as anything I can get today, if not better.

s 3.3.3

e Halfway through your stern conversion, the enemy formation  
e is not maneuvering. You've not been detected. You're ready  
e to split your flight and assign targets.

p Okay.

e How would you....

p I'm going to make an assumption now that two is now on my  
p right wing.

e Okay, would you like to have him on there with you at all  
e times? On the display?

p Yeah, I'd like to have two up.

o Display two.

e Would you want that up there all the time?

o Display wing.

p Yeah, I'd just soon have it up all the time. He could be a  
p smaller symbol, but I'd like to know where he is. I'd like  
p to have this display continue to bounce up larger, as the  
p targets come inbound, too, just like an F-15 radar scope  
p does now. Automatic upgrade.  
e Have it flexible and dynamic.  
p Yeah.  
e We're a bit constrained here, obviously.  
p Yeah.  
e Okay, what we're looking for is a command to request that  
e your wingman deploy. You said that you were assuming he was  
e out there. But let's say he's not.  
c Two to play.  
v Message sent.

s 4.1.2

e Okay, now we're moving into the prioritization and target  
e assignment phase.  
p Okay, I want two up here again now, definitely. I want this  
p display to be bigger. You can wipe out the 125 and all the  
p rest of that stuff, because I am now concentrating on this  
p flight. If, in fact, somebody else becomes a threat, then  
p I'd like him to pop into the picture, obviously, or expand  
p the display. But at this point in time, you can cut this  
p down to probably about 75 or 100 miles.  
e What you're saying is you want that blown up.  
p Yes, so I have something larger here at this point in time.  
e Okay, we'll get to that; but first we want to do this:  
v Target assignment ready.  
p I'd just say:  
c Display.  
e Here's what it gives you. It says you're targeted against  
e these two. And your wingman's targeted against....  
p Primary targeting? Best approach. Good.

s 4.1.4

e What are your intentions and concerns now?  
o Transmit.  
p So that two knows. I would assume I'd always have override  
p anyway on it. I want him to see the same display because  
p I'm assuming that my system is making that judgment based  
p upon where two is, and everybody else. Of course, what I'd  
p really like to have it do, again, is be automatic. So, when  
p it does that, it automatically transmits the assignment.  
e What are your parameters?  
p Fuel is probably not a biggie at this point in time. I  
p wouldn't be this far into the fight if it looked like it was  
p going to be. Not so much as relative geometry and cutoff,  
p where we are in relation to each other and the four of them.  
p If this were the second or third battle we just waded our  
p way through, armament left onboard would certainly be a big  
p consideration. Which means my system has to know what two's

p still got left, too. It's got to be inter-netted for it to  
p make the assignment.  
e Okay. Could you rate that then there, in 4.1.4?  
p Okay.  
e You mentioned also that you would want an override  
e capability. Let's say that came up soft anyway; and you had  
e to accept it or deny it....  
c Accept.  
o Reject.  
v Message sent.

s 5.1.2  
e As your wingman moves out to line abreast, the enemy begins  
e to maneuver and appears to merge. As you close within 35  
e nautical miles, onboard systems report a target split and  
e display the split on the horizontal situation display.  
v Targets crossed.  
e That's finally the picture you want: a little bit closer  
e scale with your wingman displayed.  
p OK, here's where your system has to automatically retarget.  
e What are you thinking about here?  
p Well, they're doing the "swap-a-bogey trick," as we call it.  
p I want to:  
c Retarget.  
p For priorities, I want two to take what's now assigned to  
p me, and I'll take what's now assigned to two, since they're  
p crossing. Okay:  
c Swap a bogey.  
p Yeah, that's a call we commonly make in this situation.  
e Okay, could you rate voice compared to usual methods?  
p Actually, I think workload's about the same because I can  
p either say it on the radio or to my airplane. And  
p usefulness is still good.  
e Here's what you get: You're assigned to those two; and he's  
e assigned to the other two.  
o Accepted.  
e Okay.

s 5.1.4  
e Any other comments here or thoughts?  
p Yeah, there is another thought: We're getting pretty close  
p to final targeting at this point in time. I want wingy to  
p know he's cleared to fire.  
e So you'd want some command, where you would say "Tell wing:  
e 'clear to fire.'"  
p Yeah.  
o Two's clear to fire.  
p or  
o Smokes clear to fire.  
p You know, whatever the call sign for the flight might be.  
p That would also allow for if I ever had two, three, four  
p wingmen, whatever it might be.

e Okay.  
p That would transmit that same type message to all of them.  
p Now they need to have, and I need to have, different types  
p of displays. Some change in the display to let me know that  
p the message had been transmitted and understood.  
e How do you change it?  
p Yeah, you could...targets initially could be displayed  
p without the color in them, for example: not solid, but,  
p just a line triangle. And then filled in red, when they are  
p in fact targeted and accepted by a particular fire control  
p system. And all that interneted between the aircraft.  
e Suppose they launch at you?  
p Yeah, I'd like to know that.  
e How would you...?  
p Good question. I have seen so many attempts at different  
p displays. Yeah, missile warning is going to be a toughie to  
p add because for everyone of those airplanes, I can envision  
p three, four missiles in the air at one time. It's going to  
p be tough. Imagine how we're going to saturate the scope  
p with the kind of information that would be required. I  
p can't give you a good answer on that one right now.  
e Would you rate that there for us?  
p Speed is probably about the same as just saying on the  
p radio. Conflict... about the same. Workload...about the  
p same. Usefulness...yeah, we gotta have it. Okay, done.  
e Okay, we were looking for a command to pass the new target  
e assignments to wingy; but, you want it auto interneted?  
p Right.  
v Message sent.

s 5.2.2  
v Targets in range in ten miles.  
e Okay, what are your concerns and intentions now? It's  
e telling you that in ten miles we'll be in range to fire.  
e What are you thinking?  
p Okay, I'm going to want something more specific than that.  
p I want a display or voice or something that tells me exactly  
p where I am in the zone, so that I have the option of when to  
p launch. Right now, I can look at this, but I don't get any  
p relationships as to where I am.  
e Just for tape purposes, since we have novices listening, you  
e are talking about "in range" versus "optimum."  
p Yeah, and the trade-off that I intuitively know that goes  
p with the decrease in range, is increasing my probability of  
p kill for any given shot.  
e Okay, what we want you to do at this point is request  
e preparation for firing at two targets. That's basically  
e what you're talking about; you're looking for a shoot cue.  
e But we'd like a little bit more detail. What command would  
e you give?  
p I'd ask for:  
c Firing display.

c Fire display.  
e Okay. Would you rate that there, please?  
p Alright...and speed...probably about the same as I can do  
p with the weapons switch, again, today. Conflict...same.  
p Workload...same. Usefulness...same. Okay.  
e Okay, once you've requested your missiles, there:  
v Master arm on, radar locked, in range, optimum five seconds.  
e It's telling you optimum time to fire is in five seconds.  
e Would you want that cueing?  
p Yeah, I like that idea. The only relationship to time that  
p I get today in the F-15, for example, is once I've fired the  
p missile, then I get a "time to go." But there's nothing  
p that gives me a time relationship about how much longer I've  
p got to hang here, with these guys targeted, before I can  
p fire and get out of here; or fire and turn around and target  
p somebody else and fire.  
e Do you want a countdown then, too? Like "Five, four, three,  
e two, one," or just "Five seconds?"  
p No, "Five seconds" is good. You know, five, ten, fifteen...  
p pretty good period of time. Yeah, guys tend to relate to  
p that. I think, anything else probably would stretch out  
p needlessly. You know, if it told me, "45 seconds to go,"  
p there is so much that happens in that 45 seconds, it seems  
p like an hour and a half. But a five-second call's probably  
p a good one.  
e "Five seconds," and then maybe a visual on the HUD "Now," or  
e something like that.  
p Yeah, some sort of shoot cue.

s 5.2.4  
e You and your wingman fire two missiles each and immediately  
e disengage. You cover your egress with chaff and flares.  
p Good. That's smart.  
e Describe your situation, concerns, and intentions.  
p Okay, what I'm interested in right now is an optimized  
p bug-out path. I don't want to run right back into the  
p target area where my ground attackers are now being shot at  
p by Triple A's and all the rest of that stuff. I also don't  
p want to take a flight path that does anything but maximize  
p my survival chances. And, so I guess my command would be:  
o Bug-out path.  
e Okay. What we want, to stay with the scenario, is to have  
e you request chaff and flares.  
p Oh, okay.  
e You gave us what we wanted to hear for the bug-out; but....  
p I haven't ever even thought of that. Guys yell "Chaff and  
p flares" on the radio. But I...there's got to be an easier  
p way to say that. This is one of them I'd have to say...  
p probably if I have a switch somewhere, like the outboard  
p pinky switch for flare dispensing. It's probably just as  
p quick to use a switch, as it would be to talk about it at  
p this point.

e How do you do it now?  
p I use an outboard pinky switch, yeah.  
e Oh, okay.  
p I can set it on "auto," or go click, click at my own pace.  
p I can set it on "auto" and then kick one flare out, for  
p example, every two seconds.  
e Is it the same switch for chaff or flares?  
p Yeah. It is right now, I think, yeah.  
e Okay. If you had to do it by voice.... We're looking for  
e some words to build a database. You'd probably always have  
e a manual backup, anyway; but let's say, for some reason you  
e wanted to say it instead....  
c Fire expendables.  
p Now I want to rate on the other side because I honestly  
p believe that I could probably do better manually.  
e That's what we want to hear.  
p Conflict...the same. Workload, I think, is poor. I think  
p it'd be easier with just a switch. And usefulness....  
e That's fine. We need to know, too, where voice isn't good.  
v Dispensed chaff and flares.

s 5.3.1  
e Okay, attack flight has knocked out the airfield and is  
e returning to base. Targets have been destroyed. And you  
e are safely out of the battle area. You request rejoin  
e information.  
c Where's two?  
e Okay, and here's what you get:  
v Wingman at nine o'clock, eight miles, line abreast.  
p Okay.  
e Is that useful information, to have it up like that?  
p Yeah, you can do it visually, aurally, or both. Either way,  
p I'd like to know where he is.

s 6.1.1  
e After you rejoin with your wingman, you pause to assess your  
e situation. What are you thinking about after the heat of  
e the battle? What sorts of concerns do you...?  
p I'm thinking about I ain't home yet. Am I back across the  
p FEBA now?  
e No.  
p No. Okay. I want an:  
o Egress path.  
e OK, what we're looking for is a system status report on your  
e aircraft at this point. What command would you give?  
c Aircraft status.  
e What do you want to know?  
p I want to know any battle damage. Weapons display like you  
p showed me a while ago, just to remind me. I know I've shot;  
p but this was a simple example. If it's a 4 V 4, at any  
p point in the flight, interrupt any guy and ask him how many  
p missiles he has left. I guarantee you, he won't remember.



e Anything else you're interested in?  
p That's pretty much it. Just a quick check.  
e Could you rate that for 6.1.1?  
p Okay, speed of that would be good because I would have to  
p check.... What I want on a display for that is exceptions.  
e Okay, like if you had a hydraulic leak?  
p Yeah, if everything is OK, fine, I don't need to know about  
p it. If everything's working within parameters, press. But  
p if there's anything outside the margins, then let me know  
p about it. Maybe a hydraulic pressure of, say, 300 pounds  
p lower than usual, that sort of thing.  
e Okay, and here's what the aircraft tells you:  
v Minimum RTB fuel; recover at alternate.  
p That's one of those things you really got to know!

s 6.1.3  
e So what are you thinking about now? No tankers available.  
e You can recover at an alternate base.  
p I want:  
c Alternate RTB.  
p Which means: Give me a flight path or vector to head me in  
p that direction.  
e Okay. Here's what we're giving you. We have a display of  
e three choices. And we give you the choice of selecting  
e which one you want.

s 6.1.5  
p Okay. Things I'm thinking about right now, I want to know  
p if all the bases are operational. Or did they just take a  
p red strike on them five minutes ago? So I'm looking for  
p that kind of input from whoever's doing the C3 role. And  
p then assuming that all of them are viable alternatives, I  
p want:  
c Best alternate.  
e If those are prioritized, based on your own personal....  
p Oh, these are prioritized? Is that why they're numbered?  
e Yeah, we'll say that they're all in range and....  
p Oh, okay. And these numbers stand for the priority?  
e Yeah. How would you select...?  
p What is the priority based on?  
e Whatever it is you want.  
p Probably the 3 main things are: airfield damage, weather,  
p and which is closest. Because I'm min fuel.  
e Well, we'd only show you what you could make fuel-wise.  
p Oh, okay.  
e So, that's the priority given. How would you pick?  
p That's the priority? Okay. Then I'd ask for, just:  
c RTB Rhein Mein.  
p Okay, and at that point, I would assume it would give me a  
p new vector, flight plan, whatever.  
v Message sent.  
e And "Message sent" means that it passed the message to you

e wingman, and the base, so they know you're coming.  
p Okay, that's interesting.

e Now we need you to fill out the personal data form, if you  
e would. While you're filling that out, we'd like to know  
e what you thought of the study; what you liked and didn't  
e like about it; and that type thing.

p "Full time/part time?" You lost me.

e Mostly we're going to Guard units with this.

p Oh. Okay.

e What prop-plane did you fly? You don't have to put that  
e down. I don't know if it's necessary. I just was curious.

p That may not be right. My hours may not all quite add up.

e That's okay. I was just curious more than anything.

p C-131's, and I've got a little time in UH-1's, helicopters.

p Not much, but....

e Didn't have to talk to your backseater very long, did you,  
e in the F-4....

p No.

e Well, what do you think? I mean, did we do a reasonable job  
e trying to get information from you? Or did we screw it up?

p The thing I found hard...probably hardest to keep in mind

p was what I was trying to rate was voice versus the way I'd

p do it today. Part of the problem in that, is that some of

p the things that you've got here, there is no way to get

p today. So I had to think, "If I had it, how would I

p activate it in the airplane?" That sort of thing. So it's

p not a pure one versus one correlation, or comparison.

e Those rating boxes are fairly useless, unfortunately.

p Yeah.

e Most guys rated the displays.

p Yeah, I found myself doing that. And I know that there're  
p probably a couple of those questions that I did that on. In

p fact, I was thinking "How useful is the information versus

p what I've got today." But you're not really looking at

p information; you want to know "How useful is a voice command

p in this particular circumstance versus what other way you

p might do it?" Okay. And that's tough. You know, our two

p most active sensory methods, especially in the airplane, are  
p voice and visual.

e Sure.

p If you were going to rate displays or providing information  
p to the pilot, then, probably, you'd want to rate somehow on  
p a scale...one to five, or one to six...what he thought a

p voice warning, or whatever, might be worth. And then he

p could rate a visual warning; and then a combination of both.

p It'd be even harder, with respect to the airplane, because

p some of these things you're going to show guys just aren't

p in an airplane today. But I guess he could still tell you

p what his opinion would be if he had to get that information

p to the aircraft or to his wingman by voice activation of the

p PA or by simply flipping a switch in the airplane. Or

p whether it should be automatic. Like some of the things we  
p talked about. That's really an issue. I mean, lots of that  
p stuff should be automatic. I don't want to be concerned  
p with all the details.  
e Good!  
p In a typical air-to-air mission, a descriptive document  
p could easily generate 1000 pages, just at the intent level:  
p what I intend to do; what I would like to do; what I would  
p like to see, etc, etc. Like the targeting situation, I know  
p that my wingman accepted it; but, it didn't tell me how that  
p was done. Whether he rogered back over the radio, or my  
p display automatically turned from blue to green, or whatever  
p it might be. If I were to take that same mission and  
p describe to you every switch activation that I would have to  
p do in the cockpit.... For example, with an F-15, to do all  
p that, I could probably make 1500 - 2000 pages out of it.  
e That's good information. Thank you for your comments.

End of Transcript - Subject 43

## APPENDIX D

### SUBJECT 8 - Biographical Data Form

Age (Years): 26  
Organization: 166 TFS, Rickenbacker ANG Base, Ohio  
Full time/Part time: Full  
Occupation: Capt, USAF  
Squadron position: Assistant Weapons Officer  
Total flying hours: 860  
Total jet hours: 860  
Total years rated: 3

Specific Aircraft (type, hours): A-7, 660  
T-38, 100  
T-37, 100

SUBJECT 8 - TRANSCRIPT

s 1.2.2  
p Where are we going to pick this up? Before the rendezvous?  
e Yes, just prior to the rendezvous.  
p OK. As a flight lead I am trying to manage everybody. My  
p biggest concerns are the experience levels of my wingmen,  
p what kind of armament we all have, the status of all our  
p airplanes. Is there going to be data-link between the four-  
p ship, so I can say, "state fuel," and the computer will say,  
p "One has 14,200; two has 13,800," etc?  
e Yes, data-link is assumed. We'll show some examples of that.  
p OK.  
e OK, here we go: The mission begins with your two-ship of  
e fighter aircraft descending through 5000 feet and 0.85 Mach  
e in the weather. Your wingman's in trail, maintaining his  
e position via data-link. You, as the flight lead, are res-  
e ponsible for accomplishing the rendezvous with the 2 attack  
e airplanes; and they're also aware of your position via data-  
e link. There's your start; you're passing waypoint two.  
p I'm always in the blue.  
e Yes, you're blue.  
p So I just passed waypoint two.  
e Yes. Also, friendlies are green, and bad guys are red.  
p Oh, OK. As long as data-link's coming back on two, and  
p we're on time, the only thing I'd question is maybe AWACS or  
p Looking-Glass, whoever's working with us for a check-in, to  
p get our timing done.  
o What state are, fighters, er, bombers?  
e OK.  
v Rendezvous data.  
e You get that message from the airplane, meaning that it has  
e more information on the rendezvous.  
c OK, go ahead.  
e OK, you already described your situations and concerns, so  
e the instruction you just gave for 1.2.2 was, "Go ahead."  
c Go ahead.  
c Speak.  
c Out with it, you.  
e Please rate that; then we'll show you what happens.  
p That's about the same, I'd say, because you gotta call AWACS  
p and wait for them to answer. You gotta call your wingman.  
p Conflict's good. Workload's about the same. Usefulness  
p depends on what it gives me. Could it give me everything I  
p want right away?  
e Yeah, what you ask for. That's the intent.  
p Oh, OK. I'm trying to think, "What's the fastest way to get  
p it to state time?" I don't know what the best way is.  
p Usually when you check in with AWACS, they come back with,  
p we fly with the Bikers and the Spads from the 1st TAC  
p Fighter Group, and they say, "Bikers are on station," or  
p "Spad is on station," or "Spad's running one minute late."

o Say state?  
 e Whatever you'd like to say.  
 o Say state.  
 e Alright. So what you get from your airplane is:  
 v Sabre-41 at fourteen miles, closing.  
 e Sabre-41 flight is the attackers.  
 p Outstanding.  
 e That's their position.  
 p Yeah.  
 o Say ETA Sabre.  
 p What time are they gonna be there?  
 e In a couple of minutes.  
 p OK, so they're fourteen miles out. Is that the same  
 p position I'm on theirs, so that everybody is in synch?  
 e Yeah, you all have the same display. That's an assumption.  
 p Oh, alright.

s 1.3.2  
 e At this point in the mission you're approaching rendezvous,  
 e as you see, and your aircraft has received a data-linked  
 e message. Sounds like this:  
 v Threat data.  
 e Concerning the discovery of new threats down range.  
 e Threat information comes from satellite and JTIDS.  
 c Show threat.  
 e OK. So that's your main concern now?  
 p Primarily. It already told me that the rendezvous is going  
 p well. I know what everybody's doing in the flight. I assume  
 p we've had a fuel check and everybody's up to speed. There  
 p are no problems I'm concerned with. Nobody has falling oil  
 p pressure or anything like that. Everything looks good.  
 e So, please rate voice to get more information. How would  
 e you rate that compared to your usual methods? We'll do the  
 e ratings, and then we'll show you what happens.  
 p ...Of "Show threat?"  
 e The command you gave. That's what the scenario calls for,  
 e too. I mean there will be times when you're interested in  
 e something, and we don't have that programmed in.  
 p Oh, OK.  
 e We'll digress, but then we'll come back to the scenario.  
 p OK.

s 1.4.1  
 e So we get the following:  
 v Tracking J band.  
 e That's all the info.  
 p If it's tracking J band, then I'd say:  
 c Activate ECM, chaff.  
 o Show position.  
 p Now, is this what it's telling me right there?  
 e Yes.  
 p What I'd want to do is go to the beam here, chaff, chaff

p into the beam and bring it back into it.  
 o Possible reroutes.  
 o What's the best way around it?  
 e So if you were to give a command to your airplane...  
 p OK, I'd say:  
 c ECM.  
 c Chaff.  
 o Show reroutes.  
 e OK. You'd give a command just like that.  
 p What's the best way around it? These are mileage rings  
 p again?  
 e Yes.  
 p OK.  
 e So, given that that command would work and give you the  
 e information you wanted, how would you rate that?  
 p Phenomenal. Do you have something better than very good?  
 p If it's coming right here within my range I'd like to see a  
 p slight red to pink area, right here.  
 e OK.  
 p Portraying my route to go this way right through the heart  
 p of the envelope of this guy, I'd say:  
 c ECM, chaff, flares.  
 o Show reroute.  
 p I would like it to know what my acceptable window is. The  
 p acceptable window of my escort airplanes for hitting that  
 p target. I'd like this thing to show possible reroutes  
 p within the constraint of our target window and least  
 p vulnerability if I say, "show reroute."  
 e That's great! Most guys have had similar concerns. They'd  
 e like a meaningful reroute, an intelligent reroute. A  
 e meaningful picture with threat windows. Alright, that was  
 e 1.4.1.

s 1.4.3  
 e That's the pictorial you're presented.  
 p If you had an ECM light over here in the bow lights, and it  
 p would just blink for a second so that I'd know that the  
 p little black box guy in the back chaffed them and has the  
 p ECM on.  
 v ECM and chaff selected; threat no factor.  
 p That's outstanding! That's what I'm talking about. I just  
 p want confirmation that it's going. Normally, right now I  
 p get my own confirmation by reaching back, making sure the  
 p chaff is on and then starting to pump on the button. I  
 p don't know if we're getting off on a tangent, but what would  
 p be outstanding is if I could say "chaff automatic;" so that  
 p anytime the airplane sensed it was being tracked, it would  
 p just go ahead and spit something out; and, as soon as that  
 p track is broken, just quit automatically. That would be  
 p outstanding.  
 e That's probably possible, considering the state of the  
 e sensors. But some guys, it seems, at least some of the ones

e we've talked to, have expressed the desire not to have any-  
e thing happen unless they directly control it. And yet there  
e are people like you that say automatic is great for certain  
e things. So there's a variability there we can work into the  
e system, too.

p I think that their concern is centered primarily on the fact  
p that we're very chaff and flare limited. We're pumping them  
p out somewhat indiscriminately: whenever we get a tone on our  
p RHAW. But if the sensors are intelligent and refined enough  
p that they know I'm locked up, if it says "Chaff now," I'm  
p gonna believe it. My feeling is, "Good, you got it; chaff  
p away, pal; chaff when ready." Do you want me to write in  
p "auto chaff?" Am I giving what you want on this?

e Even more. You're describing all your concerns.

p I assume everything's standby, full-up system, ready to go.  
p And if I just had some kind of bow lights or something, not  
p necessarily something where I gotta look down; but something  
p here when I say "chaff flare ECM," chaff comes green, ECM  
p goes green. So that I know that it's working. That's all I  
p wanna know.

v ECM and chaff selected; threat no factor.

e So you beat this, SAM-10.

p OK.

s 1.5.2

v Rendezvous data.

e The airplane tells you that, meaning it has more  
e information. Again, describe your intentions.

p Do I have a visual on these guys I'm working with?

e No. You're in the weather.

p We're totally in the weather.

o Display aircraft with lowest fuel.

p Is really what I'm concerned about.

e So that was your command for 1.5.2.

p I want to know who's got the lowest fuel.

p Does anybody have any problems is really what I'm looking  
p for. What's my call sign again? Am I Sluff?

e Sure.

o Sluff and Sabre systems check.

o Fence check.

p And, if this thing's going to data-link out to everybody, I  
p don't necessarily need a response. I only want a response  
p if somebody has a problem. That's really what I'm looking  
p for.

e OK.

p It said the rendezvous is about complete. Everybody's set  
p and on time; so, what information is it trying to give me?

p I don't understand.

o Well, how would you ask for it, to find out?

p Oh boy, everybody's in the weather. We're pushing low  
p level. I never did this before.

c Sabre, Sluff flights say state.



c Say status.  
e OK. That was for 1.5.2. Go ahead and rate that, and I'll  
e show you what happens.  
p To me, in this situation it would be about the same as  
p asking your wingman. But it might be just a little bit  
p better than that if it's faster data-link where his aircraft  
p is already feeding into mine what they're doing.  
e So you don't have to ask for it.  
p Not having to ask for it is faster. That's good.  
e That's probably the assumption. OK, and this is the  
e information you get. Visual. No voice because it's not  
e critical information. Does that tell you everything you  
e need to know?  
p Anything I need to know. The only difference would be, I  
p wouldn't run the formation in trail. I'd have two up here.  
e We've heard that consistently. You mentioned before that  
e you'd be interested in lowest fuel state. That's something  
e we could put in there.  
p That'd be the only thing I'm concerned with. If anytime I  
p say "say state," it'll display the formation and all of a  
p sudden four will blink an orange color meaning he's a 100  
p pounds below bingo or something like that. And as flight  
p leader I could say "skip waypoint four;" and that would mean  
p to the inertial nav system to take me over to waypoint five.  
p We're going to blow by point four, and take a chance running  
p over a SAM because a flight member is running out of gas.  
e OK. That's great stuff. That's the stuff we need to hear.

s 1.5.5  
e Getting back to our limited scenario here: The rendezvous  
e is complete, as you see. And your flight is escorting the  
e bombers toward the FEBA. As you approach within 25 miles,  
e your airplane cues you like this:  
v Consent for fence check.  
e What would you like to say to your airplane, if anything,  
e assuming it can automatically do the fence check?  
c Green 'em up.  
p Is basically all I'd really say. I imagine we're going to  
p have F-111 type stuff where I just bring out a floppy, plug  
p it into the airplane and it's going to know everything.  
e Probably.  
p Well, then, it's going to know my armament. It's going to  
p know where I'm going, what the threat is. If I just say:  
c You got my OK, pal.  
c Green it up.  
c That's fine.  
e That was for 1.5.5. We'll rate that.  
p I hate to seem like I'm firewalling this stuff, but flying  
p fighters would be a helluva lot easier if it would do this!  
e This is what you get in return:  
v Fence check complete.  
e The airplane takes care of everything for you.

s 1.6.1  
e Let's move on to the next phase, here, 1.6. You're  
e approaching transition to low level: 500 knots, 200 feet.  
e Your space age aircraft has full TF capability. All you have  
e to do is select values, modes, and check equipment status.  
e And, then again, you probably programmed some of that on the  
e ground before take-off. What are your concerns?  
p This thing is running me at 500 knots at 200 feet, and I'm  
p popeye. I would like it to say "Everything is working A-OK,  
p buddy." Ah, actually, what I'd like to see, even if it's  
p total hands off, is in the HUD an artificial display of  
p what's out there. Maybe I inherently don't like to zip  
p along that low without flying it. Actually, if it could  
p display something out there showing terrain and mountains  
p and why it's doing it.  
e Yeah. So you know why it's jinking as opposed to some  
e electronic foul-up.  
p Right.  
e Well, if you were giving an instruction to find out your TF  
e status, how would you do that? To make sure it's OK before  
e you go ahead and plug it in?  
c Say system state.  
c Radar status OK?  
p This would be about the same as on the A-7. For instance,  
p if your radar altimeter goes out, or it looks down and can't  
p find anything below it, it goes, "uh-oh, something's screwed  
p up." It gives you a full climb command in the HUD and in  
p the ADI, and you get a fail light on the radar. That's  
p about the same idea.  
e And that was for 1.6.1. Moving on....

s 1.6.3  
e OK, there's your successful status check. Everything's OK.  
e Set clearance plane is 200. Low altitude warning is set to  
e 100 feet. So you only need to select manual or auto. How  
e would you do that?  
p Well, if I'm in the weather, I can't see a damn thing  
p anyway...  
c Let's go auto.  
c We'll go full automatic.  
e That's your command, and your airplane does:  
v Auto.  
p I see. Yeehee! I'm now getting a constricting sphincter at  
p this point! Go ahead. We're full auto.  
e You're about to break out of the weather.  
p Whew! Uh, rating compared to usual methods? I don't  
p normally go auto down low, so.... I'll go "good" to give you  
p a lower mark. How's that?  
e Alright.

s 2.1.2  
e So here you are, zipping along low level. You're proceeding  
e at 200 feet, on course. And you have the following picture:  
p Now we got a triple A. Couple SA-6's?  
e Yeah, SAM-6, triple A. That's what your formation looks  
e like even though, like you said, you'd like this guy out  
e here.  
p I'd say:  
o Display lethal range.  
p What I'd like is a hazy area over around these to indicate  
p that. I'd like to be able to slide over a little bit closer  
p to him and stay low. I don't think the triple A is going to  
p be as big a player as that six. I want terrain masking.  
e OK.  
p But I'd like it to display its threat ranges.  
e So you're zipping along here.  
v Threat data.  
e And you get that.  
c Say threat.  
c What is it?  
c What do I got out there?  
e Those are all good commands for 2.1.2. Three commands you  
e gave us for the price of one. That's what we're looking for.  
p You want me to write that down in here, or is that what the  
p microphone's for?  
e No, you don't need to write that down. That's why we're  
e recording. Assuming you can get that info by voice...  
p Wow, that'd be outstanding!

s 2.1.4  
e So you asked for more detailed information. That's exactly  
e what we expect. And this is what you get:  
v Helicopter eighteen miles, twelve o'clock low, closing.  
e This is Blue Thunder.  
p Blue thunder.  
e He's going to eat your shorts.  
p What's the ROE here? Are we cleared for BVR engagements?  
e Sure.  
p I'd say:  
o Confirm bandit.  
e So your command there for 2.1.4 is:  
o Confirm it's a bad guy.  
e If it's red...  
p It's already confirmed.  
c Hose him.  
c Select missile.  
e OK.  
p If he's a threat to me and this is my ingress route, I'm not  
p going to run over the triple A. And I'm not going to run  
p over the SA-6 because this guy's in my way. I'd shoot him  
p in the lips right here. What kind of range do I have? I  
p don't know what kinda missiles we're talking now. Are we

p talking BVR death rays at this point, so that if I look at a  
 p target, it burns up?  
 e It's hard to say. You gave me the command you wanted. You  
 e said, "select missile."  
 c Select missile, air-to-air.  
 e Great. And if you would grade that please, then we'll show  
 e you what you get. That's for 2.1.4. The information you  
 e asked for was your air-to-air missiles.  
 v Master arm on.  
 e That's what you get.  
 p OK, I wouldn't even need to see this thing switch to a new  
 p display. As long as it says "system ready," or whatever.  
 p It knows it's an air-to-air threat. I want something I can  
 p shoot him in the lips with at 20 miles. If it says "ready,"  
 p that's fine. And something that I know the F-16s already  
 p have is, if this thing would have in the HUD an in-range  
 p cue, then I know any time from there I can take a BVR shot.  
 e Alright.

s 2.1.6  
 e So you described your intentions in 2.1.4. And what we're  
 e going to ask you to do is request the in-range cue. How  
 e would you tell your airplane to tell you when it's in range?  
 c State when ready.  
 p It says, "Yeah, you got a good PK shot now." I guess that  
 p could be programmed for what PK we're looking for. If this  
 p is a real high threat mission and we're gonna start blowing  
 p 'em off at any chance we have.... But if it's the third day  
 p of the war and we're out of ammunition already, then maybe  
 p we're going to wait until we have a higher PK.  
 o What does he have?  
 c When should I shoot?  
 o When is he a threat to me?  
 p If you could have two lights: his range and your range.  
 e His optimum shoot and yours.  
 p That has to be done just right.  
 o Smoke him.  
 o Ionize him.  
 o Take that, Ivan.  
 e You said you want two blips for in-range: his and yours.  
 p Right.  
 e Let's say that wasn't immediately available and you had to  
 e request it. How would you go about doing that?  
 c State range.  
 e Grade those again, and we'll show you what you get.  
 p You know, like I said, I hate to firewall these ratings, but  
 p this is so far ahead of what we have now that this would  
 p just be phenomenal!  
 v Radar locked, in range, optimum five seconds.  
 p Master arm's on, radar range, confirmed bogey...  
 o Hose him.  
 o Shoot.

e We envision that as always a manual task, rather than a  
e voice task to prevent an accidental shot.  
p Yeah. I wouldn't want it to be automatic. Well, shit, if  
p it's going to be automatic, send a drone up.  
e You can see you're shooting at the helicopter right after  
e the FEBA above the lake; and then the helicopter is falling  
e into the lake.

s 2.2.2  
e The helicopter goes down in flames, and you're proceeding on  
e course, but you realize that they know you're here now.  
p Alright, they know we're coming.  
e So, what you get next is:  
v Threat data.  
p SA eighteen.  
e Bad SAM.  
o Show lethal range.  
e OK. So that would be for 2.2.2. You'd want to know the  
e details of the threat.  
o Show range, ECM, chaff.  
e Please rate those.  
p Same as before. That's very good.  
e What you get:  
v ECM ineffective, reroute available.

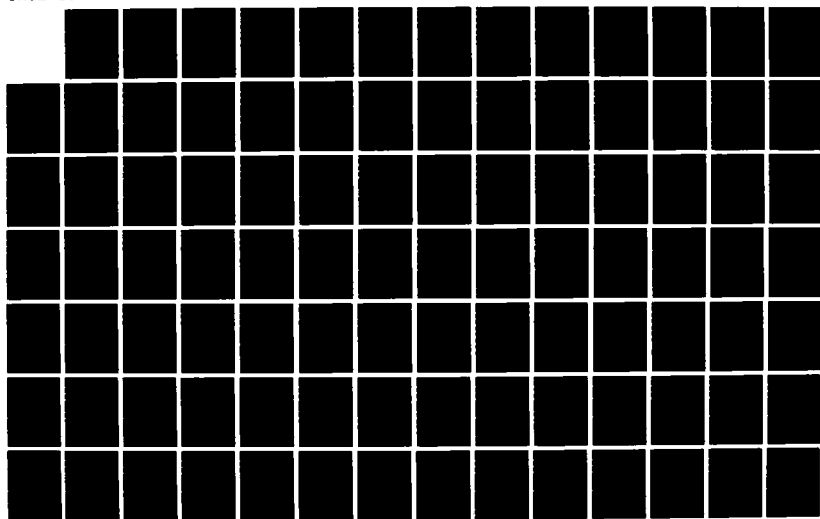
s 2.2.4  
c Show reroute.  
e That was for 2.2.4. You said, "show reroute." OK, that's  
e exactly what we want. You went ahead and graded that  
e already, it looks like. And this is what you get.  
p Perfect. That's exactly what I wanted. It's gotta show my  
p acceleration because I am now going out of the planned  
p route, and we're not doing the planned 485. Got to  
p accelerate to 510.  
o Show new bingo.  
p Is what I'd like to see. We're gonna increase our fuel  
p consumption phenomenally. Yeah, I wanna see new bingo.  
e OK. That'd be additional information. We don't address  
e that right now, unfortunately.  
p OK.

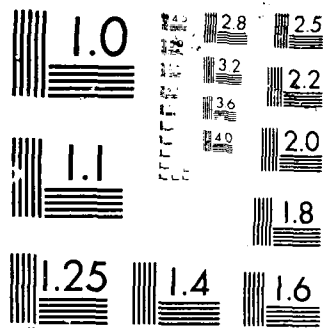
s 2.2.6  
e The scenario goes on to say that you have this reroute, and  
e you want to do it.  
p Is that where we are right there? We're cutting out to the  
p east?  
e Yeah.  
p OK.  
e You want to send that information to the rest of the guys in  
e the flight. How would you do that? How would you data-link  
e that reroute info to them?  
c Transmit.

e OK. That was for 2.2.6. Please grade it, and we'll show  
e you what you get.  
p I don't mean to be Santa Claus here in saying everything is  
p very good, but the idea of an automated reroute is terrific!  
p What we do now is: We're running along and if we can't go  
p to point five, I got to move the thing all the way over to  
p destination 07, keyboard enter, thirteen digits for lat/  
p longs, enter, data thirty-two address, change the time,  
p change the reroute time, and I'm like bluh-bluh-bluh...  
p I mean, there's smoke coming off of this thing. And I'm  
p diving into the ground about ready to hit the rocks. I  
p can't do that with all these other guys running around me.  
p It's impossible. I'm probably getting hosed by that SA-18.  
e So, for a single seat fighter that's a big advantage?  
p Oh, yes, big advantage.  
e OK. So what you get in reply from your airplane:  
v Message sent.  
p Which means?  
e Which means that the reroute has been sent to 2, 3, and 4.  
p OK, is there anyway I'm gonna get a confirmation, that they  
p know what's going on?  
e That's the intent of the voice feedback "message sent."  
p Oh. When it comes back?  
e It should say, "Sent and acknowledged" or something like  
e that. We'll have to work that out.  
p Yeah, "Sent and acknowledged." I think that'd be better.  
e OK. We'll work on that one. Next page here.

s 3.1.2  
e You're proceeding on the rerouted segment of the low level  
e at 200 feet when your aircraft reports from JTIDS an update  
e about an air threat.  
c Show threat.  
e OK, that would be for 3.1.2.  
p Now understand that as soon as I pop up, I'm now well within  
p the envelope of the SAMs, and whatever else is out there.  
p So, as soon as I start to climb I'm gonna tell this thing:  
o Chaff, ECM.  
p Is the ECM still out or was it just inop for that SA-18?  
e Just no good for the eighteen. It's their newest missile.  
p OK, so I'd say:  
o ECM, chaff.  
o Show threats.  
o Show lethal range.  
p What am I looking at? These are yellow so they're bogeys?  
e So you stated a number of issues there for 3.1.2 that  
e you'd like. If you'll rate that.... When you say "ECM,  
e chaff" did you want it to automatically puke 'em out?  
p No. If we're talking a full-up system where it can  
p determine that the SAM's in a tracking radar mode, I want it  
p to know what's looking at me. If we have that capability  
p where the operators will know that I'm locked up, then go

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p ahead and chaff. I just want it called up and ready. I  
 p want the light to come on and say "I'm ready." They already  
 p know I'm here. If it's smart enough to know what's looking  
 p at me, and it has a home-on-jam capability, then I want it  
 p to do that, too. If you can do this stuff, you can do that,  
 p I think.  
 o Chaff, ECM.  
 o Show threats.  
 o Show lethal range.  
 p Is there still mileage here?  
 e Yeah. Those are miles.  
 p OK.  
 e In this part of the scenario we're going to digress, so....  
 e Since we already covered some of the air-to-ground issues,  
 e we're gonna go with the air-to-air. Get your airplane ready  
 e for a possible air-to-air battle. How would you say that?  
 c Weapons select air-to-air.  
 e That was for 3.1.2. You already rated that. So this is  
 e what you get:  
 v Configured air-to-air.  
 e What do you assume has been done now?  
 p Program the fire control computer to be computing air-to-air  
 p distances. It's got the ECM set up for an optimal mid  
 p altitude range. I want the chaff optimized for that. I  
 p want air-to-air missiles selected. It knows the range, so I  
 p would like to have my radar missiles in priority first. As  
 p it knows the target's coming closer -- I assume I have a  
 p head-on heat capability -- then maybe it might shift to a  
 p heater. For no other reason than, if they have the same PK  
 p why blow a \$400,000 missile at them when a \$100,000 will  
 p kill them? When this comes up, I'd also like to confirm my  
 p wingman is full up and ready.

s 3.1.4  
 e Alright. We'll assume all that. The airplane turns off the  
 e TF radar and radar altimeter, remodes it to air-to-air. It  
 e configures a horizontal situation to show only suspected  
 e targets. You've already described alot of your intentions.  
 e Anything else you want to cover on this?  
 p You'd kind of get into tactics. What kind of missiles we're  
 p looking at. For optimal missiles: Is our highest PK  
 p shooting them in the lips? Do I want to set up a pincer?  
 p I'd like to know if they know I'm out there? Am I locked  
 p up? Is their radar looking at me?  
 e We'll assume they're not, yet, because they're still yellow.  
 e We'll just make that assumption for the game here.  
 p OK.  
 e If you were to request your long range missiles, how would  
 e you go about doing that? We'll take that track first.  
 p Is there any way that this would know to put your long range  
 p missiles in priority? I would imagine it would do it auto-  
 p matically.

e Let's say it doesn't.  
p If it doesn't?  
e Give the command.  
c Select max range.  
e That was for 3.1.4.  
p Like I said, unless you got the BVR death rays for 200  
p miles, it's only gonna take a second to go from a radar to a  
p heat.  
e What you get is:  
v Master arm on.  
e An acknowledgement that your command was understood and  
e carried out.  
p So we'll assume this is like an AIM-7 variant we got now?  
e OK.

s 3.1.6  
e The situation progresses to infrared search and track, which  
e the A-7 doesn't have. And it shows their relative altitude,  
e twenty degrees azimuth, range two hundred miles.  
p That's outstanding.

s 3.2.1  
e And then you get:  
v Hostile.  
p Confirmed hostile.  
e Right.  
p OK. I'd want:  
o Show max r.

s 3.2.3  
e To get a closer look at the bandits, you zoom theIRST.  
p This again goes back to the ROE. We shooting BVR shots?  
e Yes.  
p We are. OK. So I tell it, uh...  
o Track highest priority target.  
p And I guess that's not the right way to say it.  
p Well, that's what I want, but I.... At the time I probably  
p wouldn't say something as erudite as that.  
p It'd probably be more like, uh:  
o Holy shit! Get the one in front!  
p Er. Yeah. Something like that.  
p If it could sort that out, that would be real good.  
p All our air-to-air is strictly visual, like: "Oh, there he  
p is. Pitch back left." Or some quarter plane to maneuver  
p for six o'clock advantage. I've never done any intercepts  
p with radar. That's F-15/F-18 type stuff. That's what I  
p would be interested in is lock up the hoser up front.  
p That's who I want. He's the biggest threat to me. That'd  
p be real good if it would do that.

s 3.2.5 (skipped)

s 3.2.7  
e Well, we change tracks here on the next page. And ask you  
e to select your air-to-air radar.  
v In range for air-to-air radar.  
p Like we do. We're just popping off the low level now?  
e In other words, change from your IRST to radar to get a  
e closer look.  
c Show radar.  
e "Show radar" for 3.2.7.  
e That's what you get. Now they are ID'd.  
p What are you showing down there?  
e This is azimuth. It's a track while scan.  
p So. Oh, I see. They are 30 degrees off the left window.  
e So it gives you position. They're high.  
o Show range.  
o Show lethal range.  
e OK.  
p If you could put some kind of a fan out here in front of  
p them so I'd know how far out I am. I'm not going to waste a  
p missile by firing it back here because the manufacturer said  
p it should get them at a 100 miles. If I'm not entering his  
p lethal window for another 60, let's drive for 30 miles to  
p get a heart-of-the-envelope shot. That's what I'd like to  
p see. Provided he doesn't have BVR death rays!

s 3.2.9  
e So you described your concerns and asked it to show the  
e lethal range. What we're gonna do here is digress again,  
e and have you request an intercept.  
p Oh, OK. If it would know its lethal range and everything  
p else and capability of its own airplane.  
c Show optimal intercept.  
p There again. I'm not going to say that. It'd be more like:  
c Show intercept  
p or  
c display intercept.  
e 3.2.9. Good. Then we'll show you what you get.  
p When I work with GCI or AWACS and say:  
c Bogey dope.  
p The response is: "Alright, we got two of em line abreast, 14  
p miles, 270 degrees." And I think, "Well, I'm heading this  
p way; they're going that way; so they should be over...  
p there." I look for smoke. I don't see them. And, of  
p course, by now they're beaming me. GCI/AWACS doesn't say  
p anything, so I call "bogey dope," again. The reply now is  
p "Oh, he's back there at your seven." Well, thanks a helluva  
p lot! This would be ideal: If you could show his range,  
p position, bearing, and his lethal range. That's what I'd  
p like to see.  
e That's what one of the guys said earlier instead of "give me  
e details" or something. he said "bogey dope."  
c Bogey dope.

e We got that one on tape. That's a good one.

s 3.2.11

e Those are your options; your intercept options. Intercept  
e option number one is a shorter time to engage but a lower PK  
e of about 0.5. While option number two is more conservative  
e but offers a PK of about 0.98.

p If that's displayed right now I'd say:  
o Say state.

p I want to know how much fuel I have. How much additional  
p fuel did I burn going to that extra waypoint at 510 knots?  
e So fuel's a consideration?

p Fuel's a big considera...well, actually, the biggest  
p consideration. What I'd like to see here is required fuel  
p for each one and then what my fuel is over here. So I'm  
p weighing these options. I'm gonna have to mix it up with  
p four guys. Which means alot of turning and burning -- alot  
p of afterburner. How much gas do I have here? What  
p considerations do we have?

e You have plenty of gas. We'll make that assumption. Just  
e play along with this. OK?

p If we got plenty of gas, I'd go for the high PK.  
e OK.

p I'm not exactly sure how I'd ask for this yet. But, you  
p see, I'm getting a higher PK this way. Obviously, it's a  
p longer time of flight; and they're getting closer into my  
p guys who are beating up on their airfield. If it could  
p depict intercept somehow... Is that what this is doing here?  
e You mean their intercept? Or, yours?

p Where I'm gonna get them.  
e Yeah.

p That's gonna be a player for me because I want to get them  
p far enough from my guys. I want to keep them far enough  
p from my guys. If you say we got plenty of gas, I'll go  
p ahead and take option one. And, uh...that's not what I want  
p to say...take option two because it's got the higher PK and  
p I've got plenty of gas and that's still gonna intercept them  
p far enough away where they can't get my Sabre flight.

e OK. And the command you'd give?  
c Fly to two.

p Something like that.  
e OK.

p I only say "fly to two" because the A-7's got a thumb wheel  
p over here for all my waypoints. You know, alot of times we  
p get all mixed up chasing somebody around. So, we say "CAP  
p three." And just thumb to three: it gives distance and  
p direction; and, we rejoin there. That would be good if I  
p could say:  
c Select two.

p And then maybe this one would fade, and show me doing that  
p And that would give me fly-to commands in the HUD.

e 3.2.11. That was the command: "Show two" or "select two."

e You used several different options there, which is great.  
e And this is what you get: It's all programmed in now.  
p I wouldn't even be so concerned with seeing this laid out  
p pictorially. I already knew that's what it was gonna do.  
p I'd rather see in the HUD now: Cut thirty right and climb;  
p or cut thirty left, descend. And that kind of stuff. What  
p I'd also like in conjunction with this is.... Are you people  
p talking total HUD now? Like the F-16 has with the TD box?  
p The target designation box? It slides around. If that  
p thing could put.... I know we're talking BVR set-ups, but if  
p it could depict, over here, "This is where you're gonna pick  
p 'em up." You see, if I'm cutting thirty right, I'm gonna  
p pick em up about right here, slightly high. What am I, ten  
p thousand feet now?  
e Sure.  
p They're gonna be slightly high on the horizon at about ten  
p thirty or eleven o'clock. And if you could have that TD box  
p coordinate with where the target is. That's a throwback to  
p always doing visual setups. But I'd like to actually see  
p the guy if I can. So even if we are going BVR setups, the  
p computer knows where it is. It shouldn't be that much more  
p in the software to throw something up.  
e Sure.  
p That's where you're gonna see him if you do see him.  
e OK. Alright. Yeah, that's what we need.  
p I don't know if we're gonna have contact lens input so we  
p have "six million dollar man" vision. I don't know if  
p that's part of the game, too.  
e I don't either.

s 3.2.13

e You described your concerns and intentions. And now we'll  
e ask you to send this information to number two.  
p Yeah.  
o Select two.  
p Which would be this particular option.  
c Transmit.  
e OK, 3.2.13. Please rate that and then we'll show you...  
p Well, that'd be excellent.  
v Message sent.  
e You get a "message sent" which means two has confirmed.  
p That's ideal. Now I know two has this on his scope. He  
p knows what I'm doing. So he sees this hiyukka to the right;  
p and, he doesn't figure I'm maneuvering for the relief tube.

s 3.2.15

e Some of the issues you talked about. But since we're trying  
e to get some different vocabularies we'll do some other  
e things, now. One of the things we thought about was: would  
e you like to know how the bombers are doing against the air-  
e field?  
p Yeah. That seemed to come up everytime I asked for an ops

p check or "say state." If they would come over here in the  
 p green -- and maybe like a steady green -- I'd know that  
 p they're OK.  
 e You'd like that constantly displayed?  
 p Yeah. Something like that. If they're jumped.... This is a  
 p problem we experience with some of the packages we fly: We  
 p are never CAPed the whole way. We'll run in, and the eagles  
 p (F-15's) will call "Eagle 61's a contact; 050 for 40 miles."  
 p Then poof, they're gone. They're out of the fight. We're  
 p wondering, "What are you chasing him for? He's no threat."  
 p But, you know, they're off. They're gonna be aces. First  
 p day of the war and they're, poof, out of there. So there we  
 p are alone and unarmed again. I wouldn't want my CAP  
 p engaging a guy at 125 miles. Of course, in this scenario,  
 p we're talking BVR death rays 20 years from now. Maybe the  
 p bandits are threats at 125 miles.  
 e Yeah.  
 p If that's the case then, yeah, I want our CAP to engage  
 p them. Being a mud slinger I'm gonna be one of the guys over  
 p here (pointing to attack flight). But, I don't want this  
 p guy chasing shadows. If he wants to shadow box, he can do  
 p that at home. I want him to hang around with me, down here.  
 e Sure.  
 p So if in his airplane he gets some kind of a display down  
 p here that indicates: "Hey, we're mixing it up with some-  
 p body. Why don't you come back and help us? We'll deal with  
 p the other bandits 200 miles later when they get here." That  
 p would be a real good idea.  
 e OK.  
 p So if you want, maybe, a vanilla statement like:  
 c Say state  
 p or  
 c ops check.  
 p Everytime I say "ops check" or "say state," well then I want  
 p all this information: Who's the low guy on fuel? And  
 p whether or not they're in trouble. If it would just depict  
 p their position from me, that would really be beneficial for  
 p the rendezvous. We're getting ready to get out of there.  
 p Maybe their display could be flashing, if they're in  
 p trouble. Yeah, somebody's in trouble. If he's data-linking  
 p to me that, "Somebody's snipping at my heels over here."  
 e Or a voice.  
 p Or a voice.  
 p Yeah. "The mudders need help," or "Wingman needs help."  
 p And I could say, "say who?" Then this thing would say,  
 p "Sabres five o'clock, 20 miles are engaged." Then I could  
 p break off this attack and go back with that one. I think  
 p that would be a real good idea.  
 e OK. We used a lot of good words there. I think we got all  
 e those for 3.2.15. And what you get is:  
 v IP inbound.  
 e They're IP inbound.

p Super! That's fantastic! So I know they're OK.  
p Then I can be an ace. If they're OK, then I'll go chase  
p these guys. My primary concern is CAP for those guys.  
e OK.

s 3.3.1  
e And one of the things you talked about before was something  
e on your HUD to give you some command steering.  
p Yep.  
e OK. We have the ability to do that. To give you like a GCI  
e vector. How would you ask for that, specifically?  
p Well, when I ask for bogey dope, I want to know what's up  
p there. Just to give you a new term, a phrase alot of guys  
p might revert to if they're under stress is:  
c Snap vector.  
c Snap vector fight.  
p And what I expect GCI to reply is "Roll out 270 and extend."  
p They're giving me an angle on this guy for a pinch or  
p whatever I'm setting up for. "Snap vector" would be a good  
p command, I think.  
e OK. That was for 3.3.1. That's excellent.  
p What does it give me when I say that?  
e We're not supposed to show you before you rate it.  
p Oh. OK.  
v Vector zero six zero.  
p Super. Yeah. That's exactly what I want.  
e We didn't want to bias you too much.

s 3.3.3  
e OK, you're halfway through the stern conversion. The enemy  
e formation isn't maneuvering. It looks as though you've not  
e been detected. You're ready to split your flight and assign  
e targets. Describe your situation, concerns, and intentions.  
p If they're just motoring along. They're in close now? Is  
p that what this is depicting? Or is this a mile spread? Or  
p is this a staggered battle box? Or what do we have here?  
e Yeah, battle box.  
p OK. Then I'd say:  
o Assign targets; transmit.  
e OK. Good. That's 3.3.3. And what we're gonna have to do  
e is finally get your wingman out to line abreast. He's been  
e stupid. So how would you transmit that?  
c Assign targets.  
c Transmit deploy.  
e OK.  
v Message sent.  
p OK. So he's out. That means I want a "1" on these two  
p targets, which means those are mine; and a "2" on these two,  
p which means those are his.  
e OK.  
p And I want him to be getting separate vector information  
p from me. So maybe he's gonna be running about 270 or

p something like that. As long as that "message sent" lets me  
p know. And I'm gonna see him peel off to go that way. So I  
p assume he's gonna know.  
e He splits right for this scenario.  
p OK.

s 4.1.2  
e The computer, here, can figure out target assignments --  
e optimal target assignments.  
p OK.  
e How would you get that information if it didn't come  
e up automatically?  
c Assign targets.  
e OK. That was for 4.1.2. Oops.  
v Target assignment ready.  
e OK. Sorry.  
c Display.  
e There ya go.  
p That's right. There ya go. That's exactly what I want.  
p I'd like a heading, a vector, and now uh...  
o State in range.  
e OK. Let's rate this real quick.  
p Sounds really...it's real good.

s 4.1.4  
e The display shows lead targetted against those guys,  
e and wingman against those guys. And they're color coded,  
e and all that fancy stuff. Well, you need to make sure the  
e wingman has the assignments now.  
c Show assigned aircraft.  
o Deploy.  
o Transmit.  
p When I saw him peel off and it said "message sent," I  
p assumed he had this on his screen, also.  
e OK.  
v Message sent.  
p Yeah. That's what I wanted.  
e That was 4.1.4.  
p That would be really good. Normally, it's: "Go fighting  
p wing." or "Split." "Take the guy on the right." And then  
p it's five minutes of: "Which one are you?" "My nose is up."  
p "Rock your wings." This would be phenomenal, yeah.

s 5.1.2 and 5.1.4  
e OK. So here we go with the actual air-to-air. Your wingman  
e moves out, finally. The enemy begins to maneuver. And it  
e looks like they're merging. They close within 35 miles.  
e And you get this:  
v Targets crossed.  
e So they're doing some fancy maneuvering. That's you.  
e That's the wingman. They're trying to confuse you.  
c Reassign.



o Transmit.  
 e OK. That was for 5.1.2. That's exactly what we're looking  
 e for. Please rate it. Then I'll show you what we get.  
 e You get two messages because you said, "Reassign" and  
 e "Transmit." So the computer reassigned the targets and  
 e transmitted the new plan to your wingman. So that was also  
 e for 5.1.4.  
 o Reassign.  
 c Transmit.  
 e OK. Great.  
 v Message sent.  
 p Thank you.

s 5.2.2  
 v Targets in range in ten miles.  
 p I was just going to ask "bogey dope" for an update on that.  
 p I see. Is this going to be a continuing updated display?  
 e Yes.  
 p They'll be movin' along now? So I don't even have to  
 p request it. OK. "In range." Is that what it said?  
 e In ten miles.  
 p Oh, in ten miles. That's fine. I really have nothing else.  
 p Two's got his new targets. It said it transmitted back. I  
 p assume he's got them. I see him out there maneuvering. I  
 p assume he's following effective formation tactics. Hey,  
 p we're just along for shits and giggles now! Another ten  
 p miles, we'll hose them.  
 e OK. If you were to give an instruction to your airplane to  
 e get ready to fire at two guys simultaneously, or near  
 e simultaneously, how would you do that?  
 c Pick biggest threat.  
 p And I'd just want it to lock onto that.  
 n What's the biggest threat to me? I assume it's gonna be  
 p this guy. We'll see what happens.  
 e And what you get is:  
 v Master arm on, radar locked, in range, optimum five seconds.  
 p Three, two, one... Fire!

s 5.2.4  
 e You and your wingman fire two missiles each and immediately  
 e disengage. You cover your egress with chaff and flares.  
 e Describe what you're thinking about.  
 p Uh. I'd say:  
 o BDA.  
 o Target assessment.  
 o Did we get 'em?  
 o What happened?  
 p I get the impression we just fired. And split for the dirt.  
 o Bogey dope.  
 o Do we have falling metal behind us?  
 p Or do we have a Flogger at 700 knots on our tails?  
 p Oh, we got 'em both.

e Just in case. You might want to use some countermeasures.  
e How would you get your ECM?  
c Chaff.  
c ECM.  
e OK.  
p Here again, I'm going back to that premise that the sensors  
p are going to know when to spit out chaff.  
e OK. Alright. Give that a quick rating on 5.2.4.  
p That'd be really good. Then I'd say:  
o Bogey dope.  
v Dispensed chaff and flares.  
e OK. So it did the chaff and flares for you.  
p Another thing I'm looking at now is bogey dope.

s 5.3.1  
e OK. Targets have been destroyed. And you're safely out of  
e the battle area. You request rejoin information with your  
e wingman.  
p I'd say:  
o Ops check.  
p As soon as I no longer am so wrapped up with those guys,  
p I immediately want to know what the mud slingers are doing.  
p What's the deal with them?  
o Ops check.  
e They hit the airfield; they're on their way home; they're  
e OK.  
p We'd probably have some type of rejoin point -- a lake or  
p something like that.  
e OK, for this scenario you're not going to escort them home.  
p Oh. OK.  
e So we'll assume that part of the war is over. But you have  
e to find your wingman.  
c Snap vector two.  
p That's what I want.  
e That's for 5.3.1.  
p Boy, if I lost him in the merge, I should be sent home.  
v Wingman at nine o'clock, eight miles, line abreast.  
e That's the information you get.  
o Close it up two.  
o Transmit.  
p I want him at 12,000 feet, line abreast. And I want it to  
p transmit to his airplane: "Leader's there; bring it in."  
p He's no good at eight miles. Well, I don't know, maybe in  
p new airplanes, that's where he's supposed to be.  
e Well, that's the information you get. We'll assume that  
e that's joined up. He's going to do what you tell him to.  
p OK.  
e He's a good wingman.  
p What a good deal.

s 6.1.1  
e And now you're going to pause to assess your situation.  
e See if you got any bullet holes. Or whatever else is on  
e your mind?  
c Say state.  
e That was for 6.1.1.  
e And that's exactly what we're asking for in the scenario.  
v Minimum RTB fuel; recover at alternate.  
p Oh, fantastic! That's wonderful!

s 6.1.3  
p Is it gonna know all this from the floppy I put in about  
p what we need to go to each base? I assume we're back safely  
p across the FEBA, outside the range of their SA-10s, etc. I  
p would like it to come up with optimum climb and cruise. And  
p then max range descent. Give all that in the HUD. I'd just  
p say:  
o Max range descent.  
p It should give me 221 knots indicated and idle power, just  
p floating down to save fuel.  
e Yeah, it's smart enough to do that. It's all preprogrammed.  
e The only thing it needs to know is which alternate you want  
e to go to. So if you were to ask for your options, what's  
e out there now to go home to?  
p Well, if it's that smart... If this is full time war, it's  
p gonna know which base might have been hammered. Well, I'd  
p say:  
c Display bases.  
e OK, that was for 6.1.3. You get that out here.  
p Do these numbers indicate the bases' conditions?  
e No. That's more for selection.  
p Oh, just an ID. So I could say:  
o Fly to one.  
e Yeah. Something like that. Might be better to say the  
e base. But, that's not our concern now.  
p Numbers might be easier there.  
e Maybe so.  
p Then if it doesn't understand, I could just hit the display.  
p Yeah. If I said some base name like "Boo shear." I say "Boo  
p shear," and it says "Gesundheit, where do you want to go?"  
p Yeah, I'd like to know the status of each one of these. If  
p this one has a cratered runway, I don't want to be going  
p there. If this place has nerve gas all over it, if this one  
p has the strippers, I'd rather go to Ramstein.  
e You want their location and condition...color coded?  
p Yeah, if it's war: green is OK; yellow damaged; red gone...

s 6.1.5  
e Select an alternate. How would you say that?  
c Number three.  
v Message sent.  
p That's fine.

e That means your wingman and the base know what to expect.  
p What a deal. OK.

e OK. That's it for the scenario. Please tell us what you  
e liked or didn't like about the scenario.  
p Well, to be honest with you, this is so far ahead of  
p anything we're dealing with now. If you could get the bugs  
p out of something like this -- like you said, whether or not  
p it could understand somebody with a southern accent,  
p somebody that lisps, somebody that has a fly stuck in his  
p microphone or something -- that would be outstanding. What  
p I'd like to see is min-comm environment. I assume that  
p data-link is gonna be much tougher to jam than radios. When  
p I say "say state," if it would come up with info about the  
p things that the flight lead wants to be assessed about,  
p like: Two's in a backup inertial mode. So I know who my  
p players are. I know who's got the best jet, if I need to  
p reassign the flight and figure tactics. I'd like to be able  
p to put that up here. Also, in the heat of mixing it up with  
p somebody else, in the middle of that engagement, where I'm  
p asking for snap vectors for the fight, bogey dope, and all  
p kinda neat stuff, if I could come back to a statement  
p like.... Instead of "say state," which is going to give me  
p fuel and things like that, say "show friendlies." And that  
p would say that my guys attacking the airport are OK. That's  
p what I wanna know. Right now, like I said, the biggest  
p problem is the F-15's pickup a bandit at 60 miles, and say  
p "We're out of here. You're on your own." They smoke off.  
p I don't really want that. I want my package to stay  
p together. So, whatever displays you put up to enhance that  
p would really help. Um...what else? This is beyond what  
p you're doing here; but that idea of the total HUD...to  
p display that stuff, that TD box like the F-16's have. You  
p know with us, they call traffic to us. And unless it's the  
p Empire State Building at 50,000 feet, we can't pick it out  
p with our radar. Maybe we can pick out the tanker on  
p occasion. But, if we could have a TD box for when it says  
p "Bandits here." Just put it up there. I realize these are  
p BVR setups, but...it's kind of a warm fuzzy, I guess. Maybe  
p this is difficult for me to make this transition from all-  
p visual engagements. So this is a nice blanket and a warm  
p bottle for me to have that box up there so I know where to  
p look.  
e That's important.  
p Because that's something I relate to. Boy, if you guys can  
p pull this off, this will be alright!  
e We're only working a very small piece of it, you know. Our  
e work is with contractors: tell them what words to recognize  
e under what conditions, and all that. And they haven't had  
e much direction up till now; so we're getting junk.  
p Yeah. I can see that. I'd really encourage you to listen  
p to some of the tapes out here. It's hysterical, guys. For

p some of these engagements a pilot will say: "Left, left,  
p left, left, left. Go left." And then he gets all wrapped  
p up in this; but he's not paying attention to this other guy.  
p And then the wingman's like...you get him to "Slide in,  
p break right." These are things that we'd be saying. These  
p are very pedantic answers to some of this stuff. If it was  
p proper English, which it wouldn't be, it's gonna be "Break  
p left!" or "Get your head out of your ass!" That's what this  
p thing is gonna have to understand.  
e Thank you very much for your cooperation!

End of Transcript - Subject 8

## APPENDIX E

### SUBJECT 18 - Biographical Data Form

Age (Ycars): 38  
Organization: ASD/TACSO (HQ TAC liaison)  
Full time/Part time: Full  
Occupation: Fighter Pilot (liaison with ATF SPO)  
Squadron position: IP, flight commander (last assignment)  
Total flying hours: 2400  
Total jet hours: 2400  
Total years rated: 14

Specific Aircraft (type, hours): F-4, 1000  
T-38, 1100  
T-39, 200  
T-37, 100

SUBJECT 18 - TRANSCRIPT

s DEMO EXCERPTS

p I just wanted missile select. I'm going to master arm  
p myself with a switch.

e We would already have done a fence check, prior to this  
e situation.

p Yeah, but you've got the weapons. And, to me, what I'm  
p going to ask the WSO or this machine to do is to select my  
p weapons, as opposed to other weapons that I have. But  
p master arm, to me, regardless of how sophisticated we get,  
p year 2025 or whatever, it's got to be a physical switch. It  
p has to be one that I got to reach for. That's just me.  
p That's one that I want to make the movement. Because that's  
p a kill. I want that somewhere in the sequence. Well, this  
p is the problem: I would rather miss one going on the range  
p or miss a kill, than kill accidentally because of a computer  
p error. That's one I think I'm going to have to stay old-  
p fashioned with.

s DEMO, still...later on....

p Or moving the pinky switch. See I'm built for the pinky  
p switch. You know, that's a time in the flight where I  
p probably have time to say that without any conflict. For  
p selecting the missile.

s DEMO, still....

e So you'll ask a question of the system then and ask if the  
e SAM is in the range.

p Yeah. If I got a good lock. Whatever kind of an  
p indication. If it's a visual or whatever. I'd rather have  
p a visual indication of a good lock because that's something  
p that my eyes can flick back and forth and know at all times,  
p rather than having to ask it. But you need a positive  
p indicator of when it's in range. That's one of the big  
p problems with firing air-to-air missiles now is there's a  
p lot of interpretation. If the system electronically knows  
p when it's in range, either it is or it isn't. So if the  
p parameters are met, I want to know. And then when I'm  
p ready, I'm going to shoot them. If I have a valid lock and  
p I'm in range, I'm going to squeeze the thing off sometime in  
p there. If I have a good visual cue, I will probably prefer  
p that.

s START OF SCENARIO

s 1.1.2

e Prior to the rendezvous we're on the enroute descent coming  
e down through 5000 feet in IFR conditions. Your wingman's in  
e trail. He's maintaining his position via data-link.

p We're at 0.85?

e Yeah. You're the lead for the whole mission. And you're  
e responsible for accomplishing the preplanned rendezvous with

e the two attack aircraft which also know your position via  
e data-link.  
p OK.  
e Your aircraft displays a situation display for you. Shows  
e you that you're on the route of flight. And you just passed  
e waypoint two. Shows you that your wingman's in trail where  
e he's supposed to be at this point in time.  
p OK, "waypoint" is a SAC term. Let's use "turn point."  
p You guys using "waypoint?"  
e Laboratory uses it.  
p It's no good. Get rid of it.  
e Your aircraft reports that rendezvous information is  
e available to you:  
v Rendezvous data.  
c Let me have it.  
e That was for 1.2.2. Describe what your situation is, your  
e concerns and your intentions.  
p On this one?  
e Yeah. You just got that information about rendezvous data.  
p If there is threat data, am I going to get that  
p automatically?  
e Yeah.  
p Situation's OK. This is a normal situation. Things are  
p going as planned. No sweat. I'm ready for more information.  
p I'll just press on with this.  
e How would you command your aircraft to give you that  
e information?  
p What information did it just say?  
e "Rendezvous data."  
c Give me the data.  
e OK. That's the same thing we ask you to ask for.  
p I really have doubts now about how much I want him to tell  
p me. What it is, is a WSO who's always ready to offer some  
p information without the judgment of a WSO. I think this  
p guy's going to get in my way. What I'm getting at is this  
p may be a one-way system until certain circumstances. I  
p don't know as I want the computer talking to me when it  
p comes up. It won't have the intuition to repeat as needed  
p or something.  
e How would you feel that capability of voice would impact you  
e there, on this scale?  
p When I said "give me the data?"  
e Yes.  
p I think it would be better. Speed? That's another switch  
p that I don't have to ask for. That'd be nice. Conflict? I  
p don't know. Workload? That'll help. Usefulness? Yes.  
v Sabre 41 at 14 miles, closing.  
e It gives you the information that it has available.  
p That's great.  
e It tells you that the wingmen are coming in. They're  
e closing on you. They know what your position is.  
e Everything's hunky-dory.



s 1.3.2  
e And then little bit farther down the track you receive other  
e data-linked information concerning new threats down range.  
e This information is coming to you from a satellite or JTIDS  
e sources:  
v Threat data.  
e Reports surface to air threat twenty miles ahead of you.  
e And the cue "threat data" advises you that there is more  
e threat information available, that you can ask for.  
p I think I can see what you are talking about.  
e What are your situation concerns?  
p My situation is I've got some more situational awareness  
p here. I know where the flight is that I'm concerned with.  
p That's good. I've got a warm fuzzy about that. I got new  
p threat data. And that's going to be my primary concern. If  
p it's within 20 miles, my concerns are: am I in its range?  
p My concerns aren't that this formation is in good shape,  
p because they know where I am, too. I'm OK here. I need to  
p know that. So what I'm going to tell the airplane is:  
c Give me the threat data.  
p And that's quicker, less conflict, less workload. Very use-  
p ful. If I can ask for threat data that quick, that's good.  
e And that's what we ask you to do.  
p Press.  
v Tracking J band.  
p What did he say? Tracking?  
e That's a circle around it to show that it's tracking you.  
e It's using J band radar.

s 1.4.1 and 1.4.3  
e Describe your situation, concerns, and intentions.  
p OK. It's tracking me. And I'm told that I want to maintain  
p my heading until after rendezvous if possible. I'm going to  
p tell the wingman that I got a ten tracking on me. I'll make  
p a radio call here: "Got a SAM at one o'clock tracking me.  
p And call a visual." And what I'm going to do obviously is,  
p if this thing launches I'm going to maneuver against it. I  
p don't know how much ECM I got; but let's go ahead and get  
p some electronic warfare.  
e What would you command your aircraft to do?  
p I have to get some more knowledge of the system. I think  
p that, depending on the kind of system I have...  
e You have ECM, chaff and flares. You have anti-radiation  
e missiles, and long- and short-range air-to-air missiles.  
p OK. Well, let's press on and see if we get a launch on this.  
c Let's turn the ECM on.  
e OK. Is that how you'd say it to the system?  
p Yeah, but that depends on what kind of a system it is.  
c ECM on.  
p Obviously, my EHM is working and this display uses sensor  
p fusion. So, I'm not going to jink till I need to.  
e Right.

c ECM on.  
p And, obviously,  
o I want to be notified when there's a launch.  
p My primary task right now is I want to be looking out there  
p at one o'clock and see if I get a tallyho on it. So, I'll  
p make a radio call: "Three call the visual. I got a SAM at  
p one o'clock." And I'm going to say:  
c Give me ECM.  
c ECM on.  
p Something to that effect. That's not that big a deal.  
p Turning on the ECM with voice. This is so situation  
p dependent.  
e We understand. That's why we rate the specific situation.  
p Yeah. I think it's good. I'm making a radio call here.  
p And I think probably the wingman and I are going to start  
p talking. So I think asking for more threat data is going to  
p be good in a conflict sense because this might prevent some  
p conflict. Workload? I don't know. Usefulness here?  
p Nothing against it. I don't know if hitting a switch would  
p be better or not.  
e In this situation our scenario has you asking for your  
e countermeasure options -- a display of this information. So  
e you can either make a decision on what you want to use or  
e you can ask the system to use the most appropriate one.  
p What I meant by "ECM" was: I want to go ahead and counter  
p the system. It knows I'm here. He's tracking me. So I'm  
p going to jam it. The next thing is to jam it.  
e So your command would be:  
c Jam it.  
p If nothing else happens, I'm going to jam it. He's still  
p tracking me.  
e Your intentions are to jam the radar.  
p Yep.  
c Jam it.  
p That's good. Conflict? Those are all real good.  
c Give me chaff.  
c Give me jamming and chaff.  
v ECM and chaff selected; threat no factor.  
o Jamming off.  
e The threat's no longer tracking you now. And your flight is  
e approaching rendezvous.  
p OK. We'll press on. I'm going to be making some radio  
p calls to the other flight, Sabre flight. And, obviously,  
p I'm on course. So they'll be making a turn. And they're  
p going to be behind me. So I'm going to be leading. And  
p they're going to be navigating to make a visual rendezvous.  
p So I want them to call a visual. If I don't need this ECM  
p display anymore, I'm going to deselect that. We can leave  
p the chaff where it's at. I don't like the idea of the SAM  
p being up there. He's no longer a threat. But we'll leave  
p this. So I'll say:  
o ECM off.

p That'll be my choice.

s 1.5.2

v Rendezvous data.

e The system tells you that there's more information coming in  
e on the data-link, more rendezvous data. And if you want to  
e hear more about it, you've got to tell the machine.

c More data.

e OK. There's your additional data. Shows you that the  
e flight is in formation now. Gives you some text on where  
e they are and how fast they're going.

s 1.5.5

e You're getting ready to cross the FEBA. And as you approach  
e within twenty-five miles of the FEBA the system  
e automatically cues you to do a fence check:

v Consent for fence check.

e Now I want you to evaluate the use of voice to do the fence  
e check. As opposed to what you're used to now.

p As opposed to me going through the checklist and doing all  
p the items? If I tell it to do a fence check, is it going to?  
e Yep.

p Oh.

c Fence check.

p And that's exactly what I'd say. That's easy.

c Fence check.

c Do it.

c Go ahead.

v Fence check complete.

e Put in some evaluation there for the voice mechanization.

p It's very good except that the reason you do a fence check

p is to ensure some things are selected. I've got low

p confidence that it's done. So it gets a "poor" until I have  
p complete confidence in the system.

e OK, that's an important point.

p Workload is great. The workload is the biggest item. If I  
p can have an automatic fence check by voice, and it has a  
p level of confidence, that's a big plus.

e OK.

s 1.6.1

e Next situation is we're initiating the transition to low  
e level. Your aircraft has a full terrain following capa-  
e bility. All you have to do is select the values, modes, and  
e check status of the equipment. Describe your situation,  
e concerns, and intentions for your transition to low level.

p OK. Well, I want to get down in the dirt here. We're 25  
p miles out...let's see...500 knots 200 feet. That's fine. I  
p want to select my terrain following radar. And I want to  
p make sure that it's working properly.

e What kind of vocabulary would you use to call up that  
e display or to make those status checks?

p Well, let me see the navigation situation. Let me see the  
 p route. My situation is I'm approaching the FEBA. The  
 p formation's set. The only thing I need to know now is some  
 p threat information; but you say that's automatic. So what I  
 p need to know are some details on the terrain. I want to  
 p know where the ground is. And I want to know if I can get  
 p down to 200 and the system's going to work right. So, give  
 p me the terrain radar; and let's get down to 200 feet. So,  
 p let's go terrain following and 200 feet. And I would say:  
 c Terrain following at two hundred feet.  
 p And what "terrain following" should give me is the  
 p situation, and turn that system on. You know, whatever  
 p visual cues.... My command "two hundred feet" is where I  
 p want to fly. I would say:  
 c Give me terrain following.  
 c Go to two hundred feet.  
 o Gimme the route.  
 p I want the route again. I need to see that right now.  
 e We need an evaluation of that.  
 o Give me the route.  
 c Terrain following.  
 c And go two hundred feet.  
 p Switchology would be alot less conflict. Workload very  
 p good. Usefulness good.  
 e Here's the display.  
 p That's what I'm talking about. That's what I want.  
 e That's what I thought you wanted. Shows you that the status  
 e is OK. And you get the set clearance plane that you wanted.  
 p Set clearance plane? That sucks. I use ALOW. Is that what  
 p they use for F-16s?  
 e Yes.  
 p OK. Good. Press.

s 1.6.3  
 e All you have to do now is select a terrain-following mode.  
 p I want the route first before I select a mode.  
 e OK.  
 o Give me the route.  
 p Yeah, before I select the mode...but that's a confidence  
 p thing, too. I think if I had some really squirrely terrain  
 p I'd want to know it. I'd want to take a look at it. I want  
 p to look at it first. I need to see it.  
 o Give me the route!  
 p I want a radar picture of the route.  
 e You asked for it and it's there.  
 o Give me the route on the radar.  
 p That's my command.  
 e It'd be good if we had that display. But we don't.  
 p OK.  
 e Now, if you'll ask it to give you auto terrain following...  
 p If auto's fine, that's good.  
 c Let's go auto.

v Auto.  
e It gives you feedback to show you that it's activated.  
e Would you give me that voice evaluation there? We don't  
e have a flexible system, here, for this study...  
p It's tough if I don't know its capabilities.... You're  
p dealing with a guy that hasn't flown this.  
e Nobody's flown this one.  
p Yeah, but I don't know even how to select it. I would never  
p go anything automatic. But, "Let's go auto" sounds good  
p because I don't think that would be confused. Just saying  
p "auto" might be confusing with other things.  
e OK.

s 2.1.1  
e We're on the low level now. Transition's been completed.  
e We're at 200 feet; we're in the ingress formation. Current  
e threats are on the horizontal situation display.  
p Good.  
e It shows a combination of threats and good guys and any  
e other situational things that help you out.  
v Threat data.  
c Give me the data.  
e A voice command right off-the-bat!  
p Yeah, the situation, I think, and concerns are obvious here.  
p No, maybe they're not. The situation: I'm comfortable with  
p my flight. I'm not worried about the guns. I'm at 200 feet.  
p I'm somewhat worried about the sixes. I'm going to keep on  
p going straight ahead without any other changes. But I need  
p to know the new threat data. So automatically I'd say:  
c Give that to me.  
p So new threat is critical. That's what I want first.  
e So we got the intent and the vocabulary. Same as what I was  
e going to have you give me; so please give an evaluation.  
p That's good. I want to see what it says, too.  
v Helicopter eighteen miles, twelve o'clock low, closing.  
p I thought you said "threat data."  
e It's an air-to-air helicopter.  
p That's no threat.  
e Same missiles as a fighter. They have pretty mean  
e helicopters in the Soviet Union.  
p Bullshit! It'll never get me; not a threat. But I'll kill  
p it; it's a target. Go ahead.

s 2.1.4  
e OK, we already know what you want to do, right?  
p Absolutely.  
e And you're not real concerned about a helicopter.  
p No. Should I be?  
e Certainly. Hind helicopters? They're mean.  
p No, they're not. You watch too much TV! My situation is:  
p Everything is OK. This threat needs to be dealt with. OK,  
p I'm concerned about him. He's somebody I'm going to engage.

p I'm not going to fly around him. He's on my route...I might  
p be making a turn, but I don't believe so.  
e Nope, straight ahead.  
p It's right ahead. My concerns and intentions are to get  
p some information about him and kill him. So first thing I'm  
p gonna do is:  
o Lock him up.  
p I've already got him on my sensors. I mean, I know he's  
p there. My missiles will take him at that range. And if the  
p system's that smart and that capable, I don't want to lose  
p any of that other data. I want to keep the sixes in mind.  
p That's good, very fast. I think locking him up is a critical  
p phase. I don't know about the workload or conflict.  
e We're going to ask you to request your air-to-air missile.  
e Give me some terminology.  
c Gimme radar missiles.  
p Or let's see...we got HARMS on here, that's what complicates  
p it. We got heaters. We got radar.  
e What kind of words would you use to select a missile?  
p Probably by nickname would be the best. But...  
c Gimme radar missiles.  
v Master arm on.  
p Thank you.  
e It shows you the missiles selected. One's armed -- ready to  
e fire -- the other one's in standby for firing in sequence.  
p That's good.

s 2.1.6  
e What's your next concern, intention, situation assessment?  
p As soon as the guy's in range, I'm going to kill him. And I  
p want to have immediate threat data; that's an assumption.  
p My intentions here are to kill him. So I want to know when  
p he's in range.  
c Give me an in range.  
p "Give me an in range" is a specific thing you do with a WSO.  
p That only means one thing. And the response would be "Clear  
p to fire." or "In range." Depending on how we coordinate it.  
p Part of what I'm saying is from habit patterns.  
e Yeah. That's what we want.  
p But we might change our own ideas about what works better,  
p depending on what the system can do. See, that's the catch-  
p 22. Something easier I could learn easily. Right now I  
p don't have to think about what to call a radar missile. I  
p only used heaters, radar and a gun. But when faced with  
p several different radar missiles, we're going to have to  
p come up with a new nickname. And a weasel guy might have a  
p better idea than I would. I don't know if we're still going  
p to be calling them AMRAAMS or not. It's a long word.  
p "Gimme an in-range" is OK. It might cause some conflict.  
p So it's about the same as telling the WSO to do that.  
p Workload is going to be better. Usefulness will be better.  
e OK.

v Radar locked, in range, optimum five seconds.  
p Five seconds, I'll squeeze the trigger.  
e OK. You fire the missile. Kill the helicopter.  
p Shit hot! I knew he wasn't any threat!

s 2.2.2  
e OK. Helicopter goes down in flame. And you proceed on  
e course through the mountain valley approaching a lake.  
p We have to do a pitch up to look at the trashed chopper.  
e Your formation's still intact when you realize the explosion  
e has now highlighted your presence.  
p I'm not worried.  
e You get a new threat.  
v Threat data.  
e At twelve o'clock.  
c Give me the data.  
c New data.  
e What are your concerns?  
p Situation: Same concerns. I'm getting closer in here. And  
p their guys are shooting at me. I have to deal with the  
p threats that are on my route primarily. This is the answer  
p to the concerns and intentions. The intentions are to go to  
p the target. The intentions are to get the mudders to the  
p target. But what my job is, is anytime there's a threat I  
p have to be concerned with the threat that's on the route  
p first. And if it's an air-to-air threat, I have to engage  
p it. If it's an air-to-mud threat, I'll kill it if I can.  
p So I want more data about the eighteen.  
e OK.  
p What's an eighteen?  
e It's a futuristic SAM.  
p Jesus Christ!  
c Threat data!  
v ECM ineffective; reroute available.  
p No, I wouldn't want to hear all that in the middle of a  
p fight. I'm trying to get into it. It's like when I've got  
p the RHAW gear, and get all those beeps, I just turn the  
p audio off. Workload: that'll be good.

s 2.2.4  
p I didn't understand what he said.  
e He tells you your ECM's ineffective against this threat.  
e It's an SA-18 -- very formidable.  
p It's new shit.  
e New and improved; the onboard threat guy says, "Hey, we  
e can't jam this SA-18; we'd better just go around it."  
p OK.  
c New route.  
c Give me the new route.  
p My concerns are: I can't defend against this SA-18. I  
p don't want to drive in until he shoots at me because then  
p I'm forced to jink. If the computer has a good route for me,

p I'll take it. I want to know what it is first. So give me  
p new route data. And that's much easier than punching all  
p this INS shit up.  
e There's your new route...planned for you...tells you to push  
e it up to get to the target on time.

s 2.2.6

e What are you thinking about? Your situation, concerns...  
p Some of the understoods here are that the terrain following  
p radar knows what the obstacles are; and it has planned it  
p right. And it has also planned for other threats that are  
p right now outside my twenty mile range. And obviously one  
p of the assumptions for a new route is that it's better than  
p the other options.  
e That's correct.  
p Well, I don't automatically take it because it's doing the  
p planning. Now, what I'm going to do is tell the flight to  
p come thirty right.  
e OK. How would you do that? How would you send that data-  
e linked message? Would you say "Come thirty right?"  
p Well, I'd use a call sign:  
c Chief, come thirty right.  
p I got a good idea right here: In this circumstance, if we  
p can do as much as we can radio out with JTIDS or whatever...  
p My intentions are I'm going to take this new route. And I  
p want to keep track of the threats. How I'm going to do that  
p is I'm going to say:  
c I'll take the new route;  
p and  
c Tell the flight to come thirty right.  
p So the keys would be:  
c I'll take the route.  
p and  
c Tell the flight.  
p My computer will tell his computer. Sound good?  
e Yeah.  
p That's what I'd like to do. If they can do that, that's  
p great. Now, is that speed? I don't know how fast it's  
p going to be. Workload? Makes it easier. Conflict? I  
p reserve judgment on that. It may cause more conflict if I  
p don't have all the information. The old way of doing it, I  
p would just make a turn. They're not going to know why.  
p That's fine. And I'll make a radio call.  
e This was designed with tactics in mind:  
v Message sent.  
e You told the wingmen that you were going to do all those  
e things you just told me to do.  
p OK.  
e Good. So it did exactly what you asked it to do.

s 3.1.2

e Little farther down the track here. We're proceeding on the



e rerouted segment now at 200 feet when your aircraft reports  
e a JTIDS update that a new threat exists, an air-to-air  
e threat. You requested additional threat information  
e already. The horizontal situation display changes its scale  
e and shows you unidentified aircraft with their location,  
e speed, direction, and altitude. Your aircraft is still set  
e up for countering low altitude threats. For 3.1.2, describe  
e your situation, concerns, and intentions.  
p My job is to go get these guys. The situation is the  
p strikers are going to be able to hit the target OK. How far  
p am I from the IP?  
e OK. That's a good question that you might want to ask.  
p I would need to know the route. And if I could ask it.  
p If I could say something like:  
o Distance to IP.  
p And get an answer. I would make the decision. I might  
p delay the decision based on that answer.  
e OK.  
p Because the bogeys are pretty far away. So I think what I'm  
p going to do is:  
o Monitor those guys.  
o Distance to the IP.  
o Give me the route.  
o Let me see the route.  
e OK, three or four different commands there.  
o Give me the route.  
o Watch the bandits.  
o Flight position.  
e OK, good. What we're going to do is ask you to request a  
e reconfiguration of your aircraft for air-to-air.  
p Well, I don't want to do that yet; they're 200 miles away.  
e Yeah. OK.  
p Do I assess my commands that I just made?  
e Yes, please. That's what I want you to do. Evaluate the  
e usefulness of a voice command to your aircraft to tell you  
e that information.  
p I'm saving several switch changes by asking for that.  
p I guess what we're asking is to make this information show  
p what the data-link already knows. These are tough to  
p evaluate. I don't like your evaluation grid. But I don't  
p know why. ...The command that I gave as opposed to doing it  
p manually. Go ahead.  
e We're going to ask you to reconfigure your aircraft for air-  
e to-air, beyond visual range. Put all the sensors and things  
e in the right mode.  
c Let's go air-to-air.  
c Go air-to-air.  
e That was for 3.1.2.  
v Configured air-to-air.  
e Tells you that it turned off the terrain following radar,  
e and the radar altimeter. Remoded the radar for air-to-air.  
e Configured your HSD to show any suspected targets.

s 3.1.4  
e At 3.1.4, describe a little more about your situation,  
e concerns and intentions, now that your cockpit has been  
e reconfigured for air-to-air.  
p There was an assumption here that the reason I went to air-  
p to-air is I was close enough to the IP to get off of my  
p mudders. Also these bogeys are a threat. They're coming in  
p fast: 600 knots. OK, they're at 15,000 feet. And they're  
p heading right for my strikers. I want to go engage these  
p guys, so I made the decision to split off. I'm going to go  
p after these guys, so my concerns are to find out how many  
p there are and to find out if the system knows. If my sensors  
p know what kind of threat they are, that's important, too.  
p But the primary thing now is to find out how many bandits  
p there are, what they're going to do, and see if they're  
p trying to intercept my strikers. What I'm going to do is ask  
p this thing for information about the threat. I'm going to  
p make a radio call to the flight to tell them I'm departing  
p at left ten. And I'm going to climb out with my wingman.  
p This is just flying an airplane now. I'm just going to  
p split off and make a radio call. And I'll make the radio  
p call, as opposed to using JTIDS. I want the flight to know.  
e There could be a number of vocabulary words in the data-link  
e capability so you could send specific messages like that  
e without radio calls. I'm just telling you that for your  
e info.  
p Yeah. I'm at a loss on what commands that I might give.  
p Let me use my imagination. Let me think for a minute.  
o Tell the strikers to press.  
o Gimme bandit information.  
e OK, two good commands. Go ahead and evaluate this, based on  
e how you regularly get that information.  
p Conflict: May cause some conflict. Workload? Workload if  
p I'm thinking hard about my intercept.... OK.  
e What we ask you to do is to request the setup or the  
e selection of your long range air intercept missile.  
p Already?  
e Yeah. Just the sequence of events. We're going to do all  
e the things you asked for.  
p OK.  
e What command might you use in selecting a missile?  
c Give me the radar missile.  
v Master arm on.  
e Same feedback as before.

s 3.1.6  
e We armed the missiles. We're still closing on the target.  
e You've asked a couple of questions that are obviously rele-  
e vent. We will eventually ask for a position on the strikers.  
e We now want to answer your question about the threat.  
p Yeah.  
o Give me some bandit information.

p I don't even have to say "give me" on that one.  
 o Bandit info.  
 o Bogey dope.  
 p But you've already told me they're a threat, so I'm not  
 p going to say "bogey dope."  
 e They're a suspected threat because they're closing on you  
 e and there are four of them.  
 o Give me bogey dope.  
 p I don't know how to evaluate these damm things.  
 e OK, in this situation we're going to ask you to select a  
 e sensor -- an infrared search and track sensor.  
 c IR.  
 e That's direct enough. Here's the IR search and track  
 e display.  
 p OK.  
 e Shows you have four heat returns. That they're 20 degrees  
 e high and 20 degrees left. Your JTIDS information as input  
 e to that situation shows you that this is approximately a 200  
 e mile scale. They're about a 185 miles out.

s 3.2.1  
 e With this amount of information at 3.2.1, what kind of  
 e situation assessment are you having?  
 p OK. We're in a comm-out situation. JTIDS has given us a  
 p comm-out intercept. Which is all nice. So what I'm going  
 p to do is I'll give the system command to:  
 o Tell two to push it up.  
 p And we're going to start to intercept these guys. And,  
 p personally, I'm going to take it about 20 or 30 left. So  
 p I'm going to tell the system:  
 o Push it up.  
 p And, pre-brief with the wingman when I tell him to push it  
 p up on this kind of an intercept, 185 miles with the informa-  
 p tion I have, I'm going to pour it to it. I'm going to get  
 p double the speed of heat. And I'm going to push wingy out  
 p about 45 left, so he knows what kind of an intercept we're  
 p going to run. What we have to do is try to kill the leader.  
 p And then run on the trailer; run on this guy who's going to  
 p turn into the trailer. And if he splits out of the fight,  
 p that's fine. I'll kill him second. What we're going to do  
 p is intercept them. My commands will be tell two to:  
 o Push it up.  
 o And come thirty left.  
 e OK. And that'll be sent to the wingman.  
 p Now. What I want to do with this situation is: I don't need  
 p to track them yet. I don't want to give myself away. We'll  
 p just leave it like this. So I just would send some JTIDS  
 p information:  
 o Go kill them.  
 e Good.  
 p This is an easy war.  
 e So far.

p Yeah. As far as giving commands. You know, I'm not a big  
 p one for giving commands if I don't need to. I would initiate  
 p the intercept here. As far as what I would say, I don't  
 p think there's anything that has to be said here. You have  
 p some better ideas, though, I think.  
 e We ask you to ask for an IFF interrogation.  
 p At 185 miles?  
 e Yeah, we got JTIDS information. We got satellite and real-  
 e time intel.  
 p You got IFF that far?  
 e For this situation we do.  
 p OK.  
 c Bogey dope.  
 e Bogey dope?  
 p When I said "Bogey dope," I want to know all it has to say.  
 p If it knows it's a bandit, I want it to tell me. But I have  
 p to ask it for that? Let's see....  
 c Is it a target or a friendly?  
 c Or is it a bandit?  
 c Target: friendly or bandit?  
 p Is probably what I would ask.  
 v Hostile.  
 p "Hostile." OK, we'll just have to live with....  
 e Well, if you don't like that word.  
 p Well, that's what they normally use, you know, with AWACS;  
 p and the weapons controllers, too. I've never liked that.  
 p "Hostile," I can confuse with things. "Bandit" is better.  
 e OK.

s 3.2.3

e Now that we know it's a hostile target or a bandit, what's  
 e your assessment of the situation, concerns, and intentions?  
 p Well, let's go kill them. Same thing.  
 o Push it up.  
 p And we'll turn left, about thirty left.  
 o Give me radar missiles.  
 o Give me the missile status.  
 p I think I want to look at missile status.  
 e OK.  
 p I'm all set here. I've made my turn. And I'm intercepting.  
 p I think I would ask for missile status here. You told me  
 p they were bandits.  
 e OK. We want to zoom the display, next.  
 p Display's in zoom?  
 e First, give me an evaluation of selecting the missile, that  
 e you just said you'd like to do, with voice. Of course  
 e you've already done that before.  
 p Oh, that's much better than reaching over here. Is it going  
 p to show me that little display with what weapons I got?  
 e We'll get there eventually but...  
 p I know; there's a certain amount of role playing you can do.  
 p But role playing changes depending on what you are allowed

p to do and what you have the capability of.  
e This aircraft has theIRST, of course. And it also has a  
e capability where you can zoom-in on the target. You get  
e more definition on the target.  
p What does that mean? "Zoom in."  
e It's a magnification. So you can get more information.  
p Is that what we got? OK.  
e So if you request the zoom-in feature or the...  
c Detail.  
c Give me detail.  
e "Give me detail." OK, it shows you zoomed in.  
p That is nice. Have they turned on me now?  
e No, it centers it on your display because the seeker head  
e field of view is smaller. Shows you that you are looking  
e twenty left and twenty high.  
p Oh, I see. Great. Super.

s 3.2.5 and 3.2.7  
e And any additional concerns and intentions here?  
e Situation changed at all?  
p That kind of confused me. I don't...  
e You were just ahead of the scenario is the only problem.  
e It's not a problem. We're trying to look at more things  
e specific to the pre-engagement.  
p OK. The situation is I'm running at intercept on some known  
p bandits. I want to know my missile status. And I want to  
p know the range at all times. So what I need to do is make  
p sure that I always have the range available. And this  
p display doesn't give it to me. I'm going to go back...  
e Sort of does. It's a 200-mile scale. And you're halfway up  
e the scale.  
p Is that what it is? OK, that's fine. Very soon I'm going  
p to go to 100 mile range. I want to keep an assessment of  
p their formation because that's critical to my intercept. So  
p that's the situation. As I'm running an intercept, my  
p concerns are what the bandits are doing. And if the system  
p can show me how they're splitting up, that's good. My  
p intentions are to kill them all. My intentions are to kill  
p this guy first.  
e The left trailer?  
p Yeah, this guy. And I want my wingman to kill this guy.  
p I'm planning on killing these two right here, in short  
p order. And I'm going to put my wingman on that guy. But  
p there's a lot of good ways to do that. That's just one way.  
p So, what I'm going to do is "thank you very much, machine,"  
c Gimme back to the attack display.  
e So you want to say "gimme back?"  
c Air-to-air.  
c Go back to air-to-air.  
p Whatever my original air-to-air display was.  
o Hundred mile range.  
e Alrighty.

v In range for air-to-air radar.  
e It tells you that your air-to-air radar is capable of  
e tracking them at this range. Shows you that the onboard air  
e battle manager can give you a track analysis of the targets.  
e What they're heading...projected heading will take them to.  
c Give me bandit track.  
e OK.  
p You can solve a lot of things there. If I can use that kind  
p of a voice command, what that'll do is substitute for an  
p awful lot of switch changes and an awful lot of work on the  
p radar. If I can get the machine to give me bandit track.  
p Some more information. That's a lot of calculations and a  
p lot of adjusting. So, that would be a real nice one. Is  
p that what you're saying I can get?  
e Yes.  
c Give me bandit track.  
p Because the next thing I'm going to do is I'm going to lock  
p these guys up. And I'm going to tell the computer who to  
p lock. With track while scan, I ought to still be able to  
p track them all. I'm going to lock these guys up. When  
p they're in range, they're dead because these are the closest  
p guys. This guy might in fact be closer, but I told my wingy  
p to get him. OK, that's my intention.  
e Alright.  
p And that's my command:  
c Gimme bandit track.  
e And you just made your intentions known.  
p I asked it for bandit track. Is that what it gave me?  
e Yeah.  
p A couple of dotted lines? Don't I get Vc or anything?  
e Well, you could. But this is just our display.  
p OK.  
c Track while scan.  
p Track while scan is good.  
c Gimme track while scan.  
p I know it's tracking while scan. I want it to give it to  
p me. Oh, it told me what they are, huh? I heard these guys  
p are really mean sons of bitches. ...Kill them in a hurry.  
e It gets radar cross section. It does an analysis onboard.  
e And determines the probable aircraft type.  
p That's shit hot! I like that stuff.

s 3.2.9  
e With this new information, what are your situation,  
e concerns?  
p Tell me what the range of my long range missile is.  
e OK, I don't know what it is.  
p Let's make an assumption that it's a good, long range  
p missile. The situation is I'm fixing to kill cause I'm  
p closing on these guys...stink can't go this fast. You know,  
p I'm really moving in. My situation is these guys are bad.  
p And they're about to die. So what we're going to do is

p we're going to lock them up. I'm going to lock these two  
p guys. The wingy's going to lock him. And we're going to  
p gun this guy, probably. Next I'll tell him to:  
o Track the lead.  
p And I'm going to ask for detail. I need some way to  
p designate these two targets. With a voice command I don't  
p want to have to describe geometrically where this is at. So  
p this might be something I would do manually. But I want  
p detail. And I'm going to tell it to track this guy and this  
p guy. And that's something I'd have to do manually.  
e With a cursor?  
p I think it would be quicker than describing.  
e Or you could target the two lead aircraft.  
p Well, there's even an easier solution with what we're  
p talking about. Let's make an assumption that the computer's  
p going to number them. Then it's easy. I don't have to mess  
p with a cursor. I don't have to do anything else.  
o Lock one and two.  
o Tell the wing to lock three.  
o Track four.  
p And those are commands I would use. And if I could do that,  
p that would save about a hundred switches; and I just did it!  
e OK, this cosmic aircraft has a computer on board that calcu-  
e lates optimum intercept geometries.  
p Oh, it can do that, too?  
p I like the intercept I'm on, or I wouldn't have done it.  
e I know that. So, for 3.2.9, you'd give no command?  
p Right!

s 3.2.11  
e To stay with the scenario, I'll show you the options the  
e computer calculated. It tells you that intercept option one  
e has, due to priority number, a shorter time to engage but  
e has a lower PK. While intercept two is a little more  
e conservative but it offers a higher PK.  
c I'll take that one.  
e So you're going to say that at 3.2.11 that you would take  
e the intercept that you're on. But in this case you might...  
p In your situation I would say:  
c Intercept number two.  
p Oh, no. I'm not going to cross his nose and make a turn  
p back. I don't like that. That's bullshit.  
e At a hundred twenty-five miles out?  
p How fast...how much smash have I got?  
e I don't know.  
p With a higher PK, a PK like that, I'll say:  
c Give me option two.  
p What the hell's it going to do?  
e It'll show you.  
p Display option two?  
e OK.  
p That sounds good.

c Display option two.  
e Evaluate the voice mechanization here and then we'll go on.  
p OK. I'll give you a "very good." I don't like the scale.  
e OK.  
p "Display" is the key word here. That would be good.

s 3.2.13  
e Give me your thoughts there on the situation, concerns, and  
e intentions.  
p Well. It's going against a lot of my instincts right now.  
p You know that. This is not a good intercept. You're going  
p to catch a lot of flack for it. But given that PK is higher  
p and that's a smart tactic, which it's not, my intentions are  
p to lock up these guys. I want to prioritize the targets. I  
p want to drive around here. I want to lock these guys up.  
p So what I'll do is tell him to:  
o Lock three.  
o Lock four.  
c Tell two to lock two.  
p Something to that effect. And when I say "tell two" it  
p means send the information to him. And anytime that I think  
p that we need the radio call I'll go ahead and make it. But  
p in this sense I'm telling JTIDS to tell him. So, that's  
p what I'll do.  
o And I want detail.  
o I want some more information here.  
p The next thing I want. I've got my air-to-air missiles  
p selected. I asked for missile status. And I didn't get it  
p either. So I want my missile status. And then I want to  
p lock these guys up. After I see my missile status I want  
p more detail on this so I can lock them up.  
e Evaluate the use of voice to do those things you just said.  
p This is tough. See, that's the problem with scenarios.  
p The important thing here is not knowing.... Why don't you  
p tell me what your scenario is; and I'll give you an idea of  
p what voice commands I would make because all these choices  
p are OK.  
e We actually do that, just in a different order.  
p Alright. With what I said:  
o Give me detail.  
p That would be nice and quick.  
o Missile status.  
p I don't know. We're really setting the initial geometry up.  
p Supersonic. This is not a long way away for this situation.  
p Usefulness? OK.  
e What we ask you to do here is transmit the information about  
e the intercepts to your wingman.  
c Tell the wingman.  
e Basically, that's what you already said.  
v Message sent.  
p What did he say?  
e "Message sent."



p "Message sent." Why don't you have him say "Roger?"  
e You saw Airport '76.  
p OK, I don't like that at all.  
e Yeah, we know.  
p For this here, I don't want him to say "Message sent." I'd  
p rather have him say "I got it."  
e Something that's more natural.  
p See, "OK" might be the best answer for the artificial WSO.  
p If I give him something, instead of acknowledging by some  
p bullshit phrase that I would never use, "OK" is real good.  
p I always know it's him. And I always know that "OK" comes  
p out only when he understood what I said. "OK" is in there,  
p and it's simple.

s 3.2.15  
e OK, since you've already gone over most of your situational  
e concerns, for 3.2.15... You asked earlier to get information  
e about the strike flight.  
p OK.  
c Friendly info.  
c Give me friendly info.  
c Friendlies.  
v IP inbound.  
p Shit hot! Boy, that's easy. That's a lot easier than about  
p nine radio calls. "IP inbound." I like that a lot. "IP  
p inbound" is the right word, too. I like that a lot. That's  
p shit hot! You know how much information that just told me?  
p That told me a hundred things: that tells me that they're on  
p the way to the target; they're in a very low threat situa-  
p tion because now they're super fast; and they're on their  
p target run; and they don't need a lot of help; they are  
p within 1.5 - 2 minutes of the target; and I can completely  
p dedicate myself to this intercept here. All that info with  
p one phrase! Or "IP jinking," that means, well, we better go  
p back and help them.  
e OK, excellent.

s 3.3.1  
e Back to the BVR engagement for 3.3.1.  
p OK.  
e So you know you don't have to worry about them anymore.  
p Yeah, I can't wait to get this intercept done.  
p I'm as uncomfortable as I can be, turning my left beam to  
p these guys on the intercept.  
e OK. Situation, concerns, and intentions.  
p Well, my concerns now are how many kills can I get, because  
p I'm in good shape. These bozos are running in here in a  
p fluid four. And they don't know I'm coming. And I'm armed  
p to the teeth.  
o I want missile status.  
p Is a command I would give. Is this assumed to be an  
p accurate representation? OK, so I got enough detail.

o I need missile status.  
p I want to command him to lock up the guys I select to kill.  
p And I want to send a command to my wingman to lock up on  
p another one...well, the other two.  
e So why don't you evaluate the use of voice to command a  
e lock.  
p If i could command missile status and lock, those are...  
p I don't know about being faster. Workload? You're in  
p there. And I think usefulness would be real good, depending  
p on the situation. Those could be complex situations with  
p switches.  
e Would you like to request vectors? Your backseater, in an  
e intercept like this, will be giving you "Turn left. Turn  
e right." Our scenario has you request an intercept vector.  
p I guess I would if somebody else was running the intercept,  
p wouldn't I?  
e The smart system's going to give you the best path to put  
e the guy 45 degrees cold, or whatever.  
c Give me a vector.  
p Just like I would to AWACS.  
v Vector 060.  
p OK, good. This is fine. This is the way I would run an  
p intercept, no difference, if the computer's giving me  
p vectors on this intercept.

s 3.3.3  
e Halfway through the stern conversion. The enemy formation  
e hasn't maneuvered -- just like getting in there undetected.  
e And you're ready to split your flight to assign targets.  
p I see what you're doing. You just wanted to run an  
p intercept.  
e Yeah.  
p This is OK. They're 50 miles out. I'm almost around the  
p side.  
c Deploy.  
c Tell two deploy.  
p Now if I say it, what does it say? "Chief two deploy?" And  
p if I'm using JTIDS, "Tell," I think, is a good command.  
c Tell two deploy.  
e OK. And the reply is:  
v Message sent.  
p OK. Yeah.  
o Lock up bandit.  
p There needs to be some way to identify the bandit.  
e We'll get to that.  
o Lock that bandit.  
o Tell two to lock that bandit and that bandit.  
p I'm either going to tell them or he's going to tell them.  
p As far as helping me out, I don't know.

s 4.1.2  
e OK. We're closing in now on the target formation.  
v Target assignment ready.  
e Your aircraft reports target assignment ready. It has  
e determined the optimum target assignment.  
p Oh, is that right?  
e What kind of situation, concerns, and intentions?  
p My concerns are that I've lost control of the intercept.  
p I'm not entirely sure, regardless of how sophisticated this  
p is, that I want this. I'm role playing, now:  
c More info.  
e OK.  
p Which is different than "bogey dope" and some other things.  
p Good, I'm running the intercept. We're running around here.  
p I still, somewhere in here, have looked at the missiles  
p whether it's coming up or not. I might give the term again  
p "missile status" because I think I've shot my missiles. And  
p this is the time where you don't know.  
c More info.  
e OK. Evaluate that, to get more information.  
p To get more information, saving and switch changes is big.  
p This gets real tight around in here.  
e Right. OK. Now your display shows that you're targeted  
e against the two on the right. Your wingman's targeted  
e against two on the left. It circles the targets and shows  
e you their track.

s 4.1.4  
e Situation concerns and intentions?  
p Situation is: if this looks good, what I'll do is lock them  
p up and shoot them. My concerns are where the wingman is and  
p what he's doing. My intentions in this circumstance.... No,  
p you fucked up. I don't want to do that. My concerns are  
p this: I have a wingman deployed on my right out here...  
p Now I'm talking tactics. But for this situation, where this  
p wasn't smart, my commands would be:  
o OK, no, this is what I want to do.  
p So my concerns are to make different assignments than what  
p he chose, regardless of PK. I would assign myself to these  
p guys; and I'd give the wingman that guy. So I would say:  
o Negative.  
o One locks this guy.  
p There's got to be some way to designate.  
e To differentiate?  
p Yeah. OK. I would say I'm locking him and him.  
o Two, take that guy.  
p OK. So that's why I would give the command:  
o negative.  
o Relock this guy.  
o Give four up.  
o Give up four.  
o Relock.

p Let me think. There's a couple of things I could say.  
o Break lock on four.  
o I'll take one and two.  
p This is situation dependent here.  
e So you're rating 4.1.4?  
p Yes.  
e That's what you want to do. But, for our scenario, we ask  
e you to pass this information -- even though we recognize  
e it's not what you'd really do -- pass that on to your  
e wingman.  
p OK. I would do it on the radio. I wouldn't do it with  
p JTIDS or anything else like that because I have to be  
p sure...I want human-to-human communication -- no machine  
p interference or interpretation. This would always be a  
p radio call. I would not give the computer a command here in  
p any circumstance. I would give a radio call to take the  
p left man and the trailer.  
e And what you get is:  
v Message sent.  
p Yeah. OK. That's fine.  
e So the command is understood and carried out. Even though,  
e like you said, you'd use the radio. And also the present  
e heading gets you the right intercept.

s 5.1.2  
e As your wingman moves out to line abreast, the enemy begins  
e to maneuver and appears to merge. As you close within 35  
e miles, your system reports a split, and displays that on the  
e HSD. Target one appears to be converging on your flight.  
e Target two is attempting to separate. So, it's like:  
v Targets cross.  
p "Targets cross," he said?  
e Right, "Targets cross." Describe the situation, concerns.  
e I recognize that two is not where you want him to be right  
e now; but play along with this. That's the information.  
p OK, playing along with this in this situation...let's see...  
p That's a hard one. I'm trying myself to believe that this  
p is what happened.  
e Does it help any to say you're going to get him either way?  
e You're not going to get shot down.  
p I'm trying to think of a smart command to sort out this  
p thing. If this is what's going on and it can track for  
p forty miles, we can leave it the same. We can wait until  
p they cross. I don't really need to do anything yet. We're  
p still at forty miles. And rather than break lock this  
p early. We're both tracking a couple of people. And what I  
p need to do is see how these vectors work out. What gets to  
p me is these guys are going to split out here. And until  
p they cross paths and separate, so that they're each going  
p away from each other, it doesn't make sense to break the  
p locks or change anything at forty miles. So I probably  
p won't give any commands right here. The computer is

p watching and everything is good. What command did you guys  
p think that you might want to give? There are probably a lot  
p of them; we're just watching and thinking.  
e For the scenario we assign target number two to you and  
e target number one to wingman.  
p You reassign. You're just doing it early. That's fine.  
e We're making a lot of assumptions here.  
o Break lock.  
p That would be a radio call. In this situation we use  
p descriptive language -- whatever works:  
o Take the flight on the left.  
o Take the guy on the left.  
o The guy that's high.  
o Take the low man.  
o I'll take the high.  
o Take the leader.  
o Take the trailer.  
p OK. And they're descriptive, depending on the geometry.  
p Better way to do it is to number them on the screen. And  
p it's simpler. Then that would allow me to make a voice  
p command here.  
e Like: one, two, three, four; a, b, c, d; something like  
e that.  
p Yeah. And that would be good because that could save a  
p sequence of three or four switch changes without breaking  
p lock. My wingy's moving the radar maybe. He's maybe  
p changing the elevation a little bit. So there are about  
p four or five switch changes right now that are being taken  
p care of by voice command. So, they're good. Some of these  
p would have to be radio calls, though, I would think.  
e OK.

s 5.1.4  
e Do you want to pass that information on to your wingman?  
p Yeah, I can. That should be the next thing.  
v Message sent.  
p Yeah. Now in fact is when I would do that, when they  
p actually crossed. Now is when I would actually do that.

s 5.2.2  
e Reports target number two will be in range in ten miles.  
v Target's in range in ten miles.  
p What does that mean? In ten miles from me or ten miles of  
p their flight path? One of the things with voice you have to  
p be careful about is...  
e Timing would be more helpful, probably.  
p Yeah, these are ambiguous. And that's why I go back to the  
p same thing is:  
o Give me an in range.  
o Give me a range.  
e Alright, let's say it said "Three seconds," or whatever.  
p If it says "In range in three seconds" or "In range in five

p seconds" or "Optimum in five seconds," that's fine. And  
p then it gives me a "Now!" or something like that. Yeah, "In  
p range in five seconds." And then, "In range."  
e So your concerns:  
p My concerns are: when is this guy in range? I need to kill  
p him, because I've got four guys to kill. And I'm going to  
p need to kill him as soon as he's in range, OK. And then  
p kill the next guy. And the wingman is doing the same thing  
p with his bandits.  
o Give me "In range"  
p is my command.  
p OK. And then, obviously, my missiles are already armed up.  
e OK, rate that, and then we'll tell you what really happens.  
p That's good, OK.  
e What we'd like you to do is request preparation for firing  
e at two targets, getting back to your missile status request.  
p OK.  
c Arm two missiles.  
c Give me "In range" on both.  
e OK. And the reply is:  
v Master arm on, radar locked, in range, optimum five seconds.  
p Good.  
o In five seconds, fire one.  
e Alright.

s 5.2.4  
e You and your wingman fire two missiles each and immediately  
e disengage. You cover your egress with chaff and flares.  
p OK. You have an opportunity here for a couple more calls.  
p There are circumstances here, where once you know you're in  
p range, you're going to call out:  
o Fox one.  
p If there are multiple targets you're tracking at the same  
p time, we use the same term we use in training now. To this  
p thing here, I'm going to call "Fox one" as I squeeze the  
p missile off. That means the first one was shot. And then I  
p want "In range." I'm going to say:  
o Give me an "In range."  
p Or when it hears "Fox one," it's going to give me a second  
p "In range" call. See what I mean? Each guy might not be in  
p range at the same time. So, I call "Fox one," and then he  
p knows I fired a radar missile. Then I'll give him another  
p "Fox one," so he knows I fired the second missile. So we  
p might have a sequence where we talk back and forth for  
p multiple target tracks.  
e Right now, the plan is not to fire missiles using voice.  
p No, no, no, no. I'm just letting him know when I shot. See,  
p we're fighting two separate battles. We're each trying to  
p kill two bad guys. Each guy, the wingman and the lead, needs  
p to know when the other guy fired his two missiles at his two  
p targets. Because if I get 2 dopey missiles, or the missile  
p doesn't track, or I can't shoot the second missile, as soon

p as the missiles are off my wingman, I'm going to call over  
p and say, "Give me some help." So there is some potential  
p for some other voice commands to the airplane to make sure  
p information is passed. And right now we do it with a lot of  
p radio calls. And it's a critical phase. And there's a lot  
p of busyness here. This is when voice commands are going to  
p really help. There's a lot of chatter on the radio. Yeah,  
p that's when this stuff is good.  
e OK. Great info!!  
p When you get into more detail, you might expand this out.  
p Some little branch trees: If the first missile doesn't track  
p and the wingman got two kills, how would you want to send  
p information to him to come over? Or how would you want to  
p describe that your first missile didn't track? You wouldn't  
p want to get into the other fight.  
e So commands might be...  
o Fire two missiles each.  
o And immediately disengage.  
e OK, you told us your intentions and instructions. You rate  
e that, and then we'll tell you...  
p Where are we?  
e We just finished here.  
p OK, we fired the missiles and we disengaged. To cover  
p egress with chaff and flares, I would probably have a phrase  
p something like:  
c Defense.  
p And that would mean I want my situation again and my threat  
p data because I've just turned my tail, and I want defending.  
p And then I'm going to start getting those threats.  
e OK. And that's exactly what we want you to do on...  
p And, to me, that would be of high utility, because that one  
p command would give me a whole lot of possibilities.  
e For some more specifics, would you say anything specifically  
e for chaff or flares?  
p No, because.... You see, chaff and flares always have to be  
p there. I don't know as selecting chaff and flares is some-  
p thing I want to do by voice. The only thing I want to do  
p with chaff and flares is, if I need them, hit a button. Or  
p tell the system:  
c Dispense.  
p I don't want to have to select my chaff and flares. That's  
p something that I set in the fence check. Whatever system  
p that is, it has to be hot. There should be only one activa-  
p tion; I shouldn't have to ask for it. When I say "defense,"  
p I want the computer to give me defensive information now.  
e What we're saying is, after you shoot your missiles, you  
e want to dispense chaff and flares.  
p No, nobody's shooting at me.  
e If they were, how would you give the command?  
c Dispense.  
v Dispensed chaff and flares.  
e ...Just to keep on the scenario.

s 5.3.1  
e OK. Targets have been destroyed. And you are safely out of  
e the battle area. You request rejoin information. Describe  
e how you perceive the situation.  
p OK. Situation could be very dangerous and critical. And  
p this is when most guys get killed. So what I need to do is  
p know exactly where my wingman is. He needs to know where  
p the threats are. So, I would need to know where my wingy  
p is. And radio calls are the way we used to do it. But if  
p the computer knows where he's at, I would say:  
o Threat data.  
c And two's position.  
c Give me threat data and two's position.  
e OK, would you please rate that. And then we'll...  
p And if it can do that faster than I can, we're in there.  
e That's exactly what we're looking for except we leave out  
e the threat data specifically.  
p OK.  
v Wingman at nine o'clock, eight miles, line abreast.  
e That's what you get.

s 6.1.1  
e After you rejoin with your wingman, you pause to assess your  
e situation. It says here "Description is not needed." What  
e instructions do you give to help assess your situation?  
p I want to get some SA back.  
o Threat data.  
p Is threat data always provided? Or do I have to ask for it?  
e We'll make the assumption that threat data is so important  
e that it would be up continuously.  
p OK, because if I was still in the air-to-air mode...  
e You'd at least get a voice prompt: "Threat data." And,  
e obviously in a real cockpit you'd have more than 1 display.  
p Let's see. Obviously, I've had a fuel input. But let's see  
p how the attackers have done. I would probably say:  
o Nav info.  
c And fuel info.  
o And, uh, weapons status.  
p Those are three commands I would give to see if I could get  
p some more information.  
e Good. We're looking for the system status report.  
p Those three commands would be instead of switches and  
p gauges, which would be nice. I don't have to put my head in  
p the cockpit until I'm ready.  
v Minimum RTB fuel; recover at alternate.  
p See, that's great. Now the response like that, whether the  
p voice said it or not, is real big. It's good. It saves a  
p lot of calculations. Present fuel situation insufficient  
p for recovery at home base? There are no tankers available?  
p Shit! You never hear a guy badmouth a tanker when he's in  
p the air.



s 6.1.3  
p Where are all the bases? I need a vector to the alternate  
p first.  
c Vector to the alternate.  
p And then  
o I want the route.  
p We have a lot of different phrases that apply:  
c Pigeons to home plate.  
c Pigeons to the alternate.  
p But "vector" is the first thing because I want to start  
p turning. ...Worst thing I can do is drive the wrong way.  
c Give me a vector to the alternate.  
e Those are several commands to get to an alternate?  
p Yes.  
e What we're doing is we reverted back to a little bit of a  
e dumb thing: We want you to request a display of possible  
e alternate bases.  
p Oh, OK.  
c Give me my options.  
p And I would say it like that.  
e OK. Here's a display of possible alternates.  
p That's good. That's big time. I like that.  
e And then of course, please rate that command.  
p Workload.... Usefulness: very useful.

s 6.1.5  
p Give me vectors to, uh...  
c Vectors to Hahn.  
e That's exactly what we asked for, for 6.1.5. And you get:  
v Message sent.  
p I don't want that. I want a vector, dummy.  
e Well, the fact that you want to go Hahn. JTIDS is going to  
e say: "Hahn, expect this guy. Don't shoot him down."  
p I see.  
e So you wouldn't have to train in all the different words  
e into the system, you could just say "Alternate three" or  
e something like that.  
p Yes, that's better. You're right. As long as they're  
p labeled correctly -- just like I was saying with the  
p bandits. Or color is fine:  
o Go orange.  
p Colors sometimes are much better than numbers because we use  
p numbers so much. I don't know what the capability is, but  
p that's one that sounds exciting because it's something  
p different. And anything that's different and that  
p delineates it in a different way... So if blue was the  
p closest, and the orange was next, or something... And I  
p knew damn well they didn't have any missiles or had a lousy  
p club.... But you can use colors to change a lot.  
o Give me orange.  
o Lock orange.  
o Info on orange.

o Give me red.  
o We'll go to blue.  
p So that might be something to throw in there because colors  
p are fairly standard.  
e That's a good idea for the display folks.  
p That way, if we have the color capability, which I'm sure we  
p will... I just thought that might be something because we're  
p using numbers for everything.  
e And numbers are really hard to recognize. Color names are  
e easier.  
p And for positional description on the screen, which is a lot  
p of what we're dealing with...and transmitting something here  
p to the computer to work with, colors might be the key.  
v Message sent.

End of Transcript - Subject 18

## APPENDIX F

### SUBJECT 33 - Biographical Data Form

Age (Years): 33  
Organization: 177 Tactical Fighter Training Squadron  
Full time/Part time: Full  
Occupation: F-4 Instructor Pilot  
Squadron position: Line IP  
Total flying hours: 2525  
Total jet hours: 2525  
Total years rated: 9

Specific Aircraft (type, hours): T-38, 1200  
T-33, 35  
F-101, 760  
F-4, 530  
(F-20, 253 in simulator)

SUBJECT 33 - TRANSCRIPT

(First few situations not on tape)

s 1.3.2  
e The next thing that happens is:  
v Threat data.  
p Well, I know where he's at, I know his azimuth and range.  
p What's my armament, do I have a HARM on board?  
e Yeah.  
p Is he directly in my route of flight? I'd probably want to  
p deconflict with him now, so I'd say:  
o Deconflict flight path.  
p In here in this rendezvous area it looks like I'd probably  
p be able to go ahead and do that through the mountainous area  
p and still be able to get back.  
e What are you expecting the system to do?  
p I'd want it to go ahead and give me the optimum flight path  
p to clear his radius of lethality; but at the same time put  
p me in the same general direction so I'm not taken  
p inordinately out of the target area. The reason I don't  
p take him on head on is because I think the threat count is  
p going to be such that I'd bingo out of countermeasures  
p before I got close to him. So I'd like to save my  
p countermeasures assuming that the target's going to be  
p heavily defended.  
e If you could do the voice command to get more information on  
e the SA ten...  
c Is he active?  
e Would you say that?  
p No, I'd say:  
c Is the site active?  
p Obviously, he's putting out some RF or the system wouldn't  
p have come up with the threat.  
e Let's have you evaluate being able to ask for that with a  
e voice command.  
p There's no way I could go ahead and do that. I'm really  
p high on voice command, by the way. I'd much rather interact  
p with a machine than try to push a button on a menu.  
v Tracking J band.  
o Is he tracking me?  
e You could say that.  
p That would probably come up on an old rudimentary RWR. Is  
p he tracking my formation, or is he engaged with another  
p formation in his area? If I knew that because of some aural  
p or visual cue already, I wouldn't have to ask that question.  
p I'm assuming that if it comes back with that type of  
p response that he is tracking me, I'd go ahead and I'd say:  
o Plot alter course.  
e OK, good vocabulary.

s 1.4.1  
e We're going to reroute later on. In this instance, use a  
e command to call up the status of your countermeasures,  
e realizing you'd want to do this in real time. But if you  
e could call up a display that would show you what counter-  
e measures you had on your airplane, what kind of a command  
e would you issue?  
c Display countermeasures.  
e That shows you what you have.

s 1.4.3  
e If you could use a voice command in this situation here to  
e select jamming or chaff, what kind of a command...  
c Jam threat.  
p Would it be for the ECM? Or for chaff or flares? You know,  
p the thing that comes to mind is, "Are chaff and flares  
p necessary?" Because I would hope the system would be able  
p to take care of that without me manually having to, or  
p aurally saying "dispense chaff" or "chaff." It should give  
p the optimum number exactly, if it knows it's a ten. And it  
p knows that chaff is going to work out. Hopefully we would  
p know what the best sequence would be, and the aircraft would  
p try to do it automatically.  
e So if you could evaluate that voice command for 1.4.3.  
e Being able to select ECM and chaff.  
p Again, not a doubt in my mind that a voice command is  
p superior because, even in the F-15, I have to slew a target  
p designator over there to select that menu; and then I would  
p have to go ahead and select the target. That would take  
p easily three times the added time.  
e We're looking at voice as a redundant method of operation.  
p Would it be the primary, or would it be the secondary?  
e Some of the evaluation we're doing here is to determine  
e for which tasks it would be primary.  
p I think you'll find what we found out there: We found that  
p the guys who had a lot of flying time in older airplanes  
p tended to do target designation with their hands; whereas  
p guys who were new to the cockpit, and were also new to  
p flying, found the HOTAS way much easier and faster. And it  
p was faster because the guy was able to just look down,  
p realize where the HOTAS was, slip his target designator over  
p there in the general direction, and come back in to release  
p it. Whereas the guy who had to reach down with his finger  
p was having to look inside here, spend more time finding the  
p button, hit it, look back outside, and then look back inside  
p to check.  
e So everything's available.  
p I'd like voice to be able to bring up what menu I want, too.  
p Display weapons, for instance, rather than having HOTAS.  
p Even individually tailor the software to what I want.  
e OK, thanks for your comments. Back to the scenario...here's  
e what you get:

v ECM and chaff selected; threat no factor.  
e Tells you that jamming's effective; so you don't have the  
e threat to worry about.

s 1.5.2  
e As we cruise, we're getting closer to the rendezvous.  
v Rendezvous data.  
e A data burst to your airplane tells you that there's more  
e information available.  
c Display rendezvous.  
e This is not as high priority as a threat or rerouting or  
e anything; it just comes up visually, and you can check out  
e the formation. That is the complete formation there.

s 1.5.5  
e A little further down the line here, we're getting close to  
e the FEBA. We're in our rendezvous formation, and your  
e system should be able to give you a clue of when it would  
e be the most appropriate time, or the time that you program-  
e ed into the system, to do certain things, like a fence  
e check.  
v Consent for fence check.  
p Would that appear on all four cockpits at the same time? I  
p want to be sure the whole formation gets cued.  
e Yeah, I would think so, since it's position-generated.  
p So I wouldn't have to go ahead and tell them.  
e So for 1.5.5, what kind of a voice command would you like to  
e give to activate the fence check?  
p Possibly it should do it automatically.  
e If it says "Here comes the FEBA; do a fence check:"  
c Fence check.  
c Perform fence check.  
v Fence check complete.  
p I want it to confirm that it was complete in all four, so I  
p want "Fence check complete for Magnum and Sabre flight," or  
p something along those lines.

s 1.6.1  
e One more thing before we go low-level: we want to look for  
e a voice command to do a terrain following equipment status  
e check, a BIT check, if you would. What kind of a word would  
e you like to use to voice command that sort of a check?  
c Check nav systems.  
p I think that might be the best.  
e And if you have multiple nav systems?  
p I would want it to go ahead and perform it on all. In other  
p words, do a BIT on what were going to use. If I said "low-  
p level phase" prior to displaying that on the display, I'd  
p like it to automatically then do a BIT on all the systems  
p that would be used for that phase of flight. And then if it  
p automatically showed me the inbound route with, say, in one  
p corner of the display "status check good" or something along

p those lines.

s 1.6.3

e Shows you that it's OK and that the set clearance plane is  
e 200 feet, and the altitude low warning is set at 100 feet.  
e The radar has a low-probability-of-intercept mode where it's  
e not a continuous burst of energy.

p So, in other words, my air-to-air is degraded in this mode.  
e Yeah. If you could select your terrain-following mode using  
e voice to fly either manual or automatic flight...

p Just crossing the FEBA? I'd go ahead and say:

c Auto terrain following.

p Especially if I'm going to be a flight lead, and I'm just  
p crossing the FEBA, and I'm going to want to be displaying a  
p tactical situation. If the machine is capable of flying it  
p so I can assess the situation, damn right I'll go auto!

v Auto.

e And it gives you some feedback.

p I'd like to hear probably more than that because auto is  
p selected now. "Auto selected" might be better.

e How about a ride condition?

p No, I don't want "Hard" or "Soft" because I probably already  
p put that in sitting in the chocks, so I wouldn't want to be  
p queried on that at that particular point. It just said  
p "Auto," didn't it?

e Yeah. If you wanted it to be more specific...

p Something like "Auto flight selected," or something a little  
p bit more than "Auto" because, about that time maybe, my  
p wingman says something. I'd like to hear a little bit  
p longer phrase or maybe something that would be more  
p startling than that. Maybe, put it in a bright yellow.  
p The white with a light blue background is OK, but try and  
p make your field of view a little bit wider. And I would  
p suggest a little bit more of something more eye-catching,  
p colorwise. In other words, go pink. It's going to contrast  
p with your blue over here and your green over here.

e Make it more obvious.

p Yeah. If I heard a longer phrase, too.... Even if I had my  
p attention on something else, it would make me realize that  
p the auto has taken over.

s 2.1.2

e Further down the route, we're on the low level at 200 feet.  
e You might have a display that looks like this: Sort of a  
e combination RHAW gear display and a situation display that  
e shows your formation.

p OK, what are the A's? Are those unknowns?

e Triple A's. I tried to use symbology that everybody would  
e recognize, but it's not always successful.

p You know, I'd like to see some of that up on the HUD, too.

p You'd have to prioritize the threats, if he wants to stay in  
p the mission. The computer, hopefully, would do that anyway.

p These indicate right now that nobody's locked-on to me. But  
p if one locks-on to me, I'd like the system to prioritize.  
p If he's the only one, then display where he's at up on my  
p HUD with an indication that if you got something other than  
p a monochrome HUD you go ahead and show where his relative  
p azimuth range is with, if nothing else, then just a circle,  
p and with the info right in the center of that. And then  
p show relative azimuth to you; and if it's out of the field  
p of view, just have it flash. In other words, if it's beyond  
p field of view of the HUD, just have an identifying circle  
p flash in that azimuth direction.  
e What about 3-D?  
p If we had 3-D, that would be fantastic! If you have the two  
p line system... I assume you're going to have two films on  
p your visor now? You're going to have holographic types?  
p Boy, that would be outstanding! Then, if you're going to do  
p that, you have to remove the canopy bow, if you're going to  
p have an airplane at all that's going to have that system.  
p Are you going to project it onto the visors or onto the  
p canopy material?  
e That decision has not been made, yet.  
p You can't have a canopy bow in it. And you're going to have  
p distortion-free glass. It's the only way it's going to  
p work, because if you have anything that has a canopy bow,  
p the pilot will have focusing problems: he's focused at  
p infinity, then he comes down and hits a canopy bow, it's  
p going to cause his eyes to focus at one foot, and then he's  
p back out to infinity again.  
e We got some additional threat information coming in:  
v Threat data.  
e What are you thinking about?  
c Display prioritize.  
p Or I'll just say:  
c Prioritize.  
v Helicopter eighteen miles, twelve o'clock low, closing.  
o Lock on.  
p I want to take him out.  
e So the voice command you'd give?  
o Lock the radar.  
e What else would you expect it to have done?  
p I'd probably want to have one of my wingmen lock him on.  
p Again, trying to prioritize, I think that I have to save my  
p weapons for a little bit later on. So I would go ahead and  
p commit myself to press onto the target, and I'd have Sabre  
p three lock him on.  
e We're going to do that, we'll just take a couple of steps to  
e get there.

s 2.1.4  
e Requesting more information on the threat to prioritize:  
e If we required you to use a voice command to select your  
e radar missile...



p I'd say:  
c Arm radar.  
e And when you arm the radar:  
v Master arm on.  
e We bring up that display.  
p Put that in small letters there so it's all "master arm" and  
p "ON" and make that's the real obvious word. Put the "ON" in  
p a real obtrusive color, so I pick that out of the planform  
p right away. And also when showing my weapon status, for the  
p missile armed and locked-on, show that in a brighter color.  
p See, that immediately catches my eye: I look down, it's "ON"  
p and I see the missile. I like having the system tell me  
p that I'm already locked-on. I probably would not, after I  
p got used to the system, even look at the display. I like  
p the redundancy. Don't get me wrong; if I would have a five  
p second display time on this, and then go back to whatever  
p tactical display I was shown before.... Certainly show this,  
p with those font changes, and then return to the previous  
p tactical display.  
e Yeah, good. Now if you could evaluate being able to call up  
e your missile here in 2.1.4.  
p Versus reaching down here, no doubt in my mind.

s 2.1.6  
e For 2.1.6 we're going to have you request a lock on that.  
c Lock-on.  
v Radar locked, in range, optimum five seconds.  
p Yeah, I like that "Optimum five seconds." I'd like it to  
p say "Fire!" or "Shoot shoot shoot." At the same time have a  
p HUD cue and have the aural cue as well because I may have  
p been distracted by a rock or a tree at that point. So I  
p could even squeeze the trigger without looking. And I'd  
p like to have that versus voice in this particular case.  
p That's one consent I'd like to have: to actually pull the  
p trigger, rather than have it voice activated because of that  
p conscious action to think about pulling my trigger. I would  
p rather maintain the consent with the normal trigger button  
p in this particular case because I think, not only is it  
p traditional, but I think it would be more beneficial because  
p there would be more thought devoted to actually letting that  
p missile go.  
e In this situation, what other things are you doing other  
e than interfacing...  
p I'm still trying to look at the total tactical situation and  
p know I've got to take this chopper out, because I'm not  
p going to be allowed enough fuel. Any more course deviations  
p are probably going to cause more problems. The longer I  
p stay behind the FEBA, the greater my chances of encountering  
p a threat that I might not be able to take out. So those are  
p all things that come into mind. Probably, even though I've  
p got the system that's looking out for me, there are going to  
p be some threats that it's going to miss. If nothing else

p then a line of troops standing there with an SA-7 that he's  
p not going to know is there. So I'm going to be looking  
p outside all the times. That's why I like the old cues that  
p I don't have to come inside and look at displays. If I've  
p got the display that can come up on my helmet, that's even  
p better. I'm looking over here and I can focus on infinity  
p right on the ground and yet go ahead and see through the  
p information that I've got on the visor and realize what the  
p system is doing. Now again, if you have something like this  
p coming up, it would have to be a real short duration because  
p all I need is just a quick glance to know what this is  
p telling me, and then right back off again. But that really  
p tells me nothing that the voice has not already told me; and  
p unless there was a malfunction in the system, I probably  
p wouldn't need to have both. I'd say that five seconds would  
p be too long based on operational experience. Probably a  
p two-second time frame would be fine. If I want to call it  
p back for some reason, I could say: "Display weapon status."  
p It maybe comes up for a five-second period, then, just  
p because I want to consciously look at it; see what I got on  
p the airplane that's still ready to shoot. But otherwise I'd  
p have it just momentarily on and then right back off to re-  
p display the tactical situation.

s 2.2.2 and 2.2.4

e OK, you shoot the helicopter down in flames and proceed on  
e through the mountain valley. Your formation's still intact,  
e but you realize the explosion has highlighted your presence;  
e and that's validated by this information:

v Threat data.

p First thing I'd probably want to do is call AWACS. Ask them  
p if they registered my kill so I could paint it on the side  
p of my airplane. Either that or it automatically appears on  
p the side of my airplane! I would assume again that the  
p system is already prioritized. The eighteen is one of the  
p newest threats and probably in my mind the highest priority  
p anyway. I have highlighted myself and everybody knows that  
p we're coming. I probably want to say:

o Display alternate route.

p To see if there's a way around it. Because all of a sudden  
p now I don't want to take on an SA-18, if I can avoid it.

p It looks to me, just looking real casually, that if I came  
p right about thirty degrees, I'd probably be able to split  
p the two belts. Especially at twenty miles.

e Pretty good scenario. For your command of "Display  
e alternate route," let's have an evaluation on 2.2.4. I'm  
e going to have you do another one for 2.2.2. To back up one  
e step, what I do is: ask you to ask for more detail on the  
e threat. So if you want to get more information on a  
e threat... For some reason, in some cases, you wouldn't want  
e it to ram-dump on you all the information it had available.  
e It gives you the option of managing this information, and

e requesting additional information when you're ready.  
p In other words, if I pick the threat and prioritize myself?  
e The system has more information. It's waiting for you to  
e give it a command to go ahead and talk.  
c Display threats.  
v ECM ineffective, reroute available.  
p What was the last phrase?  
e "Reroute available."  
p Reroute available.  
c Display.  
c Display alternate route.  
p I don't like "Reroute" because I didn't understand it.  
e OK.  
p "Alternate route available," I think, is something that we  
p probably pick up on right away. So I'd say:  
c Display alternate route.

s 2.2.6  
e We have programs at Wright-Patt that are doing that realtime  
e where they can take popup threats into account and reprogram  
e your nav route to give you the least threat.  
p Good.  
e All you need to do here is determine whether or not that's  
e in fact the way you want to go.  
p OK, I'd say:  
c Magnum/Sabre coming right.  
e You want your wingmen to understand that?  
p Yeah. That's why I went ahead and added them, too. Rather  
p than have them visually know about it when I start my turn,  
p I also want them to have it displayed. Because they don't  
p know what interaction I'm having with my mission computer  
p right now anyway. They would have this info. They'd know  
p that it was there, so I would go ahead and say:  
o Display.  
o Display alternate route.  
p And then I'd say:  
c Magnum and Sabre come right.  
p So they would automatically get the same display.  
v Message sent.  
e OK. In this scenario everytime you send a message to your  
e wingman, if he gets it and understands it, it's  
e acknowledged with "Message sent."

s 3.1.2  
e OK. We're still proceeding on the low-level, 200 feet,  
e when we get a JTIDS update about an air-to-air threat, which  
e is still pretty far off in range, but something we need to  
e start thinking about. One of our displays might change to  
e show us the situation.  
p I'd still want my course line displayed as well as the  
p threats. You know, with four CRT's, I'd like it to still  
p have my course line displayed on here now that I know I've

p got some threats. But I would want an aural cue also for  
 p airborne threats.  
 e The situation is that you got this information. You  
 e acknowledged and asked for more information; so your display  
 e changed to give you that information. In our thinking of  
 e moding cockpit displays for optimization, we're thinking of  
 e displays for air-to-ground and displays for air-to-air.  
 e And switching back and forth between those modes, we're  
 e looking for a command to do that.  
 p OK.  
 e So if you were to go from an air-to-ground mode to an air-  
 e to-air mode, what would you like to say?  
 p I'd say just that:  
 c Show air-to-air.  
 o Show air-to-ground.  
 p On this particular display, I'd like to have an integration  
 p of the two.  
 e Put the nav routing and keep your threat display on there?  
 p Yeah, I would. Well, I would at the very least like to  
 p still see my ground track -- my route of flight -- showing  
 p my waypoints. And also I'd like to have some sort of heading  
 p for it if nothing else; if it differs from my heading now.  
 e So you can anticipate.  
 p You know, like on that last display. It showed me where the  
 p waypoint's at; but unless I had some visual cue up on the  
 p HUD pointing to it... If it says "Accel 500 knots," that's  
 p fine. But also say: "Heading" or "Turn right." And tell me  
 p how many degrees, that type of thing. Give me that visual  
 p display as well.  
 e We intentionally have left off a lot of the detail to try to  
 e get information -- to get your comments. When you say  
 e "Select air-to-air" for 3.1.2, how would you evaluate that  
 e compared with having to remode your cockpit?  
 p OK.  
 e This reconfigures the displays and optimizes the radars and  
 e just totally rebuilds the cockpit.  
 p OK.  
 v Configured air-to-air.  
 e Again, some feedback.  
  
 s 3.1.4  
 e If you also at this time wanted to preselect your missile,  
 e just to make sure that it was selected again...  
 c Select radar.  
 e OK, and you "Select radar" in 3.1.4.  
 v Master arm on.  
 e Same display again.  
 p Momentary only?  
 e Right.  
 p Momentary only and then back to the previous display shown  
 p on range and azimuth.

s 3.1.6  
e We're thinking about a sensor that was on the deuce (F-102).  
p IRST?  
e Yeah.  
p We had that on the F-101.  
e Oh, great! Then you can give us more information about it.  
p It's a super, super system. As long as they can filter out  
p the ground radiation that we got when we were down low, it's  
p an absolutely fantastic system. It's totally passive.  
e If you could use a voice command to call up an IRST display,  
e what would you...  
c Display heat.  
p You're not going to be able to go in and pick out those  
p guys, so it is just going to be a blob up there. But that's  
p still very useful, because you still get an azimuth on it.  
p And if you got a JTIDS range on it, well, shit, you're in  
p there like Flint.  
e And just for calling up a sensor using voice.

s 3.2.1  
e We're looking for a verbal command for an identification-  
e friend-or-foe kind of a situation.  
c Display status.  
p Even better, I like:  
c Friend or foe.  
e "Friend or foe" for 3.2.1.  
v Hostile.  
p I'd like to hear "Declared hostile" because the one word,  
p again, I might miss it. But if I hear "Declared hostile" or  
p "Friendly friendly," that will be better because you have a  
p little bit longer phrase. And you get two words that are  
p going to be more easily understood than the one word you may  
p miss in a tactical environment.  
e We've also changed the color.  
p I like that.

s 3.2.3  
e If, in fact, the IRST had a mode where you could change the  
e field of view or get a closeup, a sort of a....  
p Declutter?  
e Yeah.  
p I'd use that.  
o Declutter.  
e F-15 guys call it RAM, rate assessment mode, where it goes  
e to a zoom or closer in.  
p Yeah, basically we call that BS sharpening, doppler beam  
p sharpening, on the radar on the F-20. We didn't have an  
p IRST capable of doing that; but I would not use "declutter."  
c Zoom in.  
e We just want to get some vocabulary.

s 3.2.5  
e You might be able to break out the targets by this point,  
e too. On board systems might be able to give you a projected  
e flight path of the bogeys, based on historical data and  
e velocities, to try to give you additional information to  
e help you set up your geometries and realize what the  
e situation is.  
p I'd like it not only to go ahead and give me his projected  
p flight path, based on history, but also mine. And I'd like  
p to go ahead and have the system then tell me as soon as he  
p makes a change. I'd like it to plot my optimum intercept  
p everytime, based on the type of weaponry that I've got on  
p board. In other words, if the system knows that I'm out of  
p heaters or knows that I'm out of radar missiles, I want it  
p to plot the optimum intercept force with the type of  
p armament I still have left onboard.  
e Good.  
p I'd like that displayed primarily on a head down display;  
p but also give me a pointing vector on the HUD as well.  
e Command steering?  
p Yeah. Now, if you got that stuff on my visor or on a  
p holographic type of display, that's all that's necessary.  
e We're set up to do that for you.  
p Well, super, I can hardly wait!  
e If you could request a projected flight path or track or  
e whatever...  
c Show flight path.  
v In range for air-to-air radar.

s 3.2.7  
p It's four to my four (missiles). If I've got air-to-air  
p primary, then I'd go ahead and I'd say:  
o Show intercept.  
e If you could call up your air-to-air radar before you did  
e that...  
c Display radar.  
e Here's a computer generated detail.  
p So it knows with the radar what type of airplane it is.  
e Anything you could critique for me on that display?  
p This comes from the F-20 experience, but I also like:  
o Prioritize the targets.  
p If they're all the same priority, then leave it like that.  
p If one of them is higher priority just because he's closer  
p to me, I'd like a little tick mark that'll show that. In  
p addition, I really like the tick marks on it showing the  
p basic course of the guy. Then I can see that, as he turns,  
p the tick mark does this. And it really shows up; and I'd  
p like that constantly updated, so that it gives me an idea.  
p I can see relative movement, so I know what his drift is.  
p But if I had that tick mark, it would be easier for me to go  
p ahead and pick up his movement and his heading right away.  
p In addition, on here I would like his course and altitude

p displayed.  
e OK.  
p In other words, I know there's four, so I don't need "4  
p MIG-39's." I like "MIG-39." Below I'd like altitude and  
p speed, not necessarily in that order. And then the  
p priority, as I said, could be displayed with your series of  
p tick marks.  
e OK.  
p But I know there's four planes out there, so I don't need it  
p to tell me how many are out there. You're basically giving  
p bearing and range, and then altitude. Yeah, I know he's out  
p there at, say, 90 miles; but if I could just look up there  
p and see "93" miles...  
e I think the F-15 radar does that.  
p Yeah, all the newer ones do. And I'd like to see that kind  
p of display because you know where he's at, so you know what  
p you need to do.

s 3.2.9  
e You wanted intercept options; and we're ready to give those  
e to you for 3.2.9. All you have to do is give the command.  
c Display intercept.  
p In this particular case I want to back up a little bit.  
p Again, I'd want to go ahead and say:  
o Display heat intercept  
p or  
o Display radar intercept.  
p If I'm going to be able to take these guys on in the BVK  
p setup, then I'd say:  
o Display radar setup.  
p Assuming that my radar missiles are going to be a long range  
p missile. But I don't know whether this is showing my heat  
p intercept?  
e Well, I didn't really think of it that way.  
e I just threw two intercepts up there.  
p In other words, this is head-on, and that's going to be a  
p stern conversion?  
e Yeah.  
p If I said just "display intercept," I'd like it to come up  
p with both options. If I only have a radar missile onboard  
p and no more heaters, I'd like it to only come up with the  
p radar option. Vice versa with the heat option. But if I had  
p both, I'd like to go ahead and show both; and then I get to  
p pick which one I take, especially if I know which position..  
p I'd still like to go ahead and have the positions of my  
p wingmen displayed as well, because that would, of course,  
p also dictate how I was going to plot the intercept.  
p If I had my wingman over here on the left side, I'm probably  
p going to want to go ahead and sweep left. If they're over  
p here on the right side, I may take that option just because  
p it would be easier to maneuver my formation around for an  
p intercept phase. Also, I'd have those guys displayed. I'd

p like it to show...out of 25 mile circles, I'd delete the  
p 25, the 75, and the 125. Leave the 50 and 100, or vice  
p versa: keep the 25, drop the 50. You don't need every one  
p of those.

s 3.2.11

e I put priority numbers on there. Number one is a shortest-  
e time-to-kill, but a lower PK; while two is more conservative  
e with a higher PK.

p I'd say:

o Display high PK.

o Display fastest.

o Display best intercept.

p So I can prioritize then, which is going to be the best way.  
e From your academics, you know that one is shortest time with  
e low PK, while two is conservative with higher PK. If you  
e could use a voice command to select a mode, what would you  
e say for 3.2.11?

o Display fast intercept.

c Display highest PK.

e OK, when you say "Display highest PK," here's what you get.

p I also would like to show my wingman's at the same time, and

p I'd like him to be able to see mine. What's the lapse rate

p on this? In other words, I know this is almost going to be

p real time; but how about the transmission of that back to a

p secure source and then back to my wingman? What's the delay  
p going to be?

e Milliseconds, probably.

p Almost real time also?

e You should be able to data burst to your wingman without  
e threat.

p If I could do that, that'd be great.

s 3.2.13

e If you could data burst this decision you just made to your  
e wingman, would you like...

c Show my intercept.

e OK.

p I'd want him to automatically know that, so he'd know what I  
p was planning on doing.

e You said "Show my intercept."

v Message sent.

s 3.2.15

e We're committed to the air-to-air, but we want to get an  
e update on where the strikers are.

c Show strikers.

v IP inbound.

p I'd also like that displayed. So in other words, an

p integration of the air-to-air and the air-to-ground display  
p at that point.



s 3.3.1  
e It tells you that they're IP inbound. If you could get  
e vector information from your computer, would you like that?  
p Yeah, I want it to go ahead and display not only that but  
p also on my flight path marker and up on the HUD. Go ahead  
p and tell me directly where I'm going, and then show me how  
p I'm deviating off that. In other words, have the desired  
p course as dotted line and the actual course as a heavy line.  
e How would you ask for that information?  
c Show intercept.  
p I think would probably be the best one. And I would want  
p that automatically to come up on the original display that  
p we discussed earlier. Not only display the intercept, but  
p also give me a heading.  
v Vector 060.  
p I would not put "Vector" on there, and I'd decrease the size  
p of the font of the "060." But put it down closer to ownship  
p until it says, "Hey, you need to come right to 060." It  
p doesn't say "Right," but looking at the God's-eye view here,  
p I can see I'm going to have to come right and just go ahead  
p and put the course right up there on the course line. I  
p like the voice output, too, just to confirm.  
e That's for 3.3.1.

s 3.3.3  
e We're halfway through the stern conversion here. The enemy  
e formation's not maneuvering, yet; and it looks as though  
e you've gone undetected so far. You're ready to split your  
e flight and assign targets. What else are you thinking about?  
e We're looking for a real quick term here to send your  
e wingman out.  
p I'd like to know my formation before I went ahead and did  
p that, because I don't know his position relative to me. My  
p initial impression would be that I would want to go ahead  
p and take the far trailer and give him the near trailer; and  
p I also want us to go heat because they're not aware that  
p we're here. So I want to go ahead and hit them with heaters.  
p I shouldn't have to tell my wingman to deploy. I'd say:  
o You take the north man.  
o I got the south man.  
o Heat only.  
v Message sent.  
p Message sent? I wasn't expecting to hear that.  
e Yeah, you will. It means message sent and received.

s 4.1.2  
v Target assignment ready.  
e On board systems are going to give you what it thinks is  
e your optimum target for the missile that it also probably  
e thinks is optimum. So, if you would like to get that  
e information, you can do that just by commanding...  
p My optimum intercept with that guy?

e Targeting. Target assignments.  
p In other words, prioritizing the target?  
e Yeah.  
p I would want it to be prioritized anyway from the very  
p beginning because that's always the guy that I'm going to  
p want to go ahead and hit first. In other words, if he's  
p faster than the other guys, if they're not in formation,  
p that type of thing, I need to know that from the very first  
p time those threats pop up on the screen, rather than me  
p having a separate command for that later on, because all  
p that's going to be important to know prior to ever coming up  
p with a game plan for the actual intercept.  
v Target assignment ready.  
p I would want to say:  
c OK, prioritize.  
p I'm just looking for a brevity word.  
e I understand.  
e Here's what the computer thinks. It's going to target you  
e against the close guys.  
p Again, if I were a lead in the formation or ROE-wise and  
p common-sense-wise, I'd say:  
o Reprioritize.  
p My statement before said that I would go ahead and take the  
p south man; so I'd like the system to realize then that I  
p was going to go ahead and take this guy over here and  
p automatically then direct my wingman to this man that was on  
p the north side.  
e Would you like to touch the screen to designate those?  
p No.  
e The numbers?  
p No.  
e The colors?  
p No, I can look down and with my hands... Still assuming that  
p I'm doing some maneuvering, I'd rather go ahead and say:  
o One's got the south man.  
o Two, you take the north man.  
o Trailer.  
e What if those came up with like a one, two, three, four, and  
e you say "Two you got three, and I've got one and four."  
p That would be even better. Right now the system prioritized  
p the two north men as being ones, and that's primarily  
p because of proximity, I would think; but if it would go  
p ahead and number the guys and maybe come up with a different  
p way of prioritizing, by the highest priority maybe flash at  
p you.... That way, I could go ahead and say:  
o Lead's got number three.  
o Lead's got number four.  
o Two, you take number one.  
p That would be, I think, the best way.

s 4.1.4  
e If you wanted to send that information to your wingman to

e make sure...  
p I would want it automatically sent to my wingman as soon as  
p I said that. And realize that most of the things I've said  
p throughout today I would probably want sent to my wingmen  
p just so they would know what my thought processes were so  
p that their SA could be kept up as well. In other words,  
p they could override what displays that they saw; but if they  
p wanted to go ahead and see what I was looking at, maybe have  
p one CRT dedicated to the stuff that I was saying and what I  
p was displaying so they would be able to keep constantly  
p aware of what I was doing. And I could use that screen then  
p as my way of sending them information.  
e That's a really a good idea.  
p ...Versus me having to go ahead and dedicate a particular  
p transmission. "Send transmission" I think is NA; you  
p shouldn't have to do that. Automatically send it to them,  
p and then if they won't change their priority, they can look  
p at a different CRT to go ahead and do that.  
v Message sent.

s 5.1.2  
e As your wingman moves out to line abreast, to go for his  
e target, the targets maneuver.  
p OK.  
v Targets cross.  
e The system tells you the targets are going to cross.  
c Prioritize.  
p I'd ask them to prioritize at that point.  
e And for 5.1.2, when you say "Prioritize," what it does is it  
e switches targeting. So, being able to use a voice command  
e to reprioritize.... Or would you rather use a different word  
e to do that?  
p No. Again, I want it to do the same thing, which is  
p prioritize the targets. If I were going to manually  
p prioritize, I would go ahead and correct the system. Or I  
p could just make that determination, but not really go ahead  
p and change the display on the screen. I'd want the system  
p to be aware of what the main prioritization is. We used to  
p prioritize and be able to manually prioritize in the F-20,  
p too, and I don't see a need for that. My personal opinion  
p is I don't see a need to manually prioritize through the  
p system. I would rather be able to just go ahead and make  
p that mental determination myself and go after the guy if I  
p decide to do it then, without changing what the actual  
p priorities are according to the system basic design.  
e Oh, OK.  
p If they use range and range rate as their prioritization  
p system, I'd like to continue to get that displayed.  
e OK, you said earlier that you wanted that immediately  
e passed to your wingman.  
p Yes.  
e So we'll skip over 5.1.4.

v Message sent.

s 5.2.2

v Target in range in 10 miles.

e What are you thinking about?

p I don't want the aural cue to go ahead and tell me when the  
p optimum time to fire should be. If he's in range, I know  
p that now, so I can basically fire at any time. What you  
p could do on the HUD would be to increase the hertz rate at  
p which you are flashing the shoot cue, and when you are at  
p the optimum PK point, have it go to a steady shoot. So in  
p other words, relatively low flashing rate when you're out  
p there on a low PK with high range. As your range decreases,  
p the flash rate could increase, and then when you get to the  
p optimum PK, have it go to a steady PK shoot cue. That's  
p what I would like to see because I'm going to be looking  
p through that (the HUD) with this type of attack.

e Do you think you would have to request a radar lock?

p Before they maneuvered, we were in heat. First off, I have  
p to know if they know I am here. I assume that they've got a  
p JTIDS system. On this type of display, if they've got  
p active radar on me, I'd like to know that. I assume that's  
p already built into the system. Right now, the indication to  
p me is they do not know. There's not an active radar on me.  
e OK.

p So I would like to go ahead and hit them at a longer range  
p than they're going to be able to, or want to, hit me. So  
p I'd go ahead and say:

c Lock on radar.

p And when I say "lock on radar," that would automatically  
p select a radar missile and have it ready to go, too.  
p Rather than having to then come back and say "select radar;"  
p which means now it selects the radar missile, too. We want  
p to make it better and not worse, if I have to do two things  
p instead of one....

e For 5.2.2 when you request a radar lock:

v Master arm on, radar locked, in range, optimum five seconds.

p It might ask at that point which one to lock onto, and that  
p was where it would help if I had numerical designations  
p assigned to the Russian or the threat formation.

e Here we have two.

o Lock on one.

p Would be real easy, and we could then go ahead and designate  
p that particular guy.

e We went ahead and took another step when we had missile  
e lock onto each target. You get two missiles.

p So in other words you're going to have a track-while-scan  
p with a multifire capability.

s 5.2.4

e So you're ready to fire. Go ahead and pull the trigger, and  
e immediately disengage. And to cover your egress you put out

e countermeasures. If you could do that with voice, what  
e would you like to have as a command?  
p For a countermeasure? I want that automatically done  
p without any voice command necessary. They know that I'm  
p there already because of their vector towards me. I've shot  
p my missiles, and I'm trying to leave the scene; so it's a  
p launch-and-leave missile. I want CM automatically activated.  
p That system then will come on without me having any thought  
p directed towards that at all.  
e We'll give you aural notification:  
v Dispensed chaff and flares.  
e We do have some chaff and flares for you.

s 5.3.1  
e Targets have been destroyed, and we're safely out of the  
e battle area. We're looking for our wingman. We don't have  
e a visual.  
p I'd say:  
c Display wingman.  
p or  
c Display Sabre flight.  
e Sabre flight's gone ahead and dropped their bombs and  
e egressed back low-level. Our wingman knows just where he's  
e supposed to be. And you request "Display wingman."  
v Wingman at nine o'clock, eight miles, line abreast.  
e Please evaluate using voice to find out that information.  
p Obviously, there's no way that I could do that by hand, or  
p anything like that. It'd be way too tough.

s 6.1.1  
e We're cruising back high altitude when we pause to assess  
e our situation. If you could give a command to get a system  
e check on your airplane, to check the operation of the  
e equipment, check for battle damage...  
p Cruise check type thing?  
e Yeah.  
p I'd say:  
c Show status.  
e "Show status" for 6.1.1.  
e It would show you if there was anything that was damaged or  
e inoperative.  
p No news is good news. Basically, if everything was working,  
p I wouldn't expect to see anything. If there was a problem,  
p then I'd like it to go through a BIT and show me what the  
p problem is.  
e That's a good mode of operation. Here's a display that you  
e might get if you were into a situation where you're getting  
e low on gas.  
v Minimum RTB fuel; recover at alternate.

s 6.1.3  
p I'd want to:

c Display optimal profile.  
e OK, would you say it that way? When you say "optimal  
e profile" here at 6.1.3, it shows you the bases that you  
e could select from.  
p I would want it to go ahead and show those but, again,  
p prioritize. And, of course, that would take into account  
p not only my fuel status but also whatever problem I might  
p have with the airplane. In other words, if I've got a  
p hydraulic problem that's going to necessitate that I take an  
p approach-end barrier, and Hahn for some reason doesn't have  
p one, then I'd like it to automatically reprioritize to Rhein  
p Mein as being the next best one to go to. Could we go back  
p to the last display?  
e Sure.  
p As a suggestion: pilots are going to know these are the  
p fuel tanks here. I would not put the wave action here.  
p I would put a different colored line, and then right below  
p that I would put what each fuel tank holds, or have a  
p central display showing how much gas I actually have on  
p board, rather than a digital display that you've got over  
p here on the right side. But the wave action that lets me  
p know its liquid... Just go ahead and have it a different  
p color line so that it would actually show the amount on  
p board.  
e OK.  
p It's like 800 and 800, and then total.

s 6.1.5  
p When it came up with the next display, I'd like it to....  
p Yeah, this gives me a God's-eye view, but I'd also like it  
p to have...show climb, cruise, and descent profile. So  
p probably off on the same screen would be helpful or maybe on  
p a different CRT...  
e That might be the next step. Once you pick your profile or  
e your base that you want to get into that would generate the  
e profile.  
p That sounds good to me. Well, if you're going to have an  
p MLS system, I'd go ahead and fly it from the profile anyway.  
p In this particular case, if it shows me what my options are,  
p I'd say:  
c Display Rhein Mein.  
p Automatically hoping...allowing them to come up with the  
p optimum climb, cruise, and descent profile to get me there.  
e And when you said "Display Rhein Mein" at 6.1.5:  
v Message sent.  
e We would appreciate your critique.

End of Transcript - Subject 33

## APPENDIX G

### SUBJECT 20 - Biographical Data Form

Age (Years): 37  
Organization: 159 Tactical Fighter Squadron  
Full time/Part time: Full  
Occupation: Fighter Pilot  
Squadron position: Operations Officer  
Total flying hours: 2700  
Total jet hours: 2700  
Total years rated: 13

Specific Aircraft (type, hours): F-100, 600  
F-4, 950  
F-15, 150  
T-38, 1000

SUBJECT 20 - TRANSCRIPT

s 1.2.2  
e For this scenario, I want you to think about yourself being  
e the flight lead of a two-ship escorting two attack aircraft.  
e You'll be coming in from a medium altitude IFR condition  
e down to a low altitude, low level, under the weather.  
e You'll be rendezvousing with the attackers and then flying  
e across the FEBA into a high threat area prior to the IP.  
e There are air-to-air capable helicopters and surface-to-air  
e threats along the way. You'll be using terrain following  
e radar for your two hundred foot AGL ingress. You get  
e information, real time intelligence kinds of things, from  
e satellite or some intelligence distributing network like  
e JTIDS. When we get close to the point where the bombers are  
e going to go off on their own, we get information about a  
e four-ship of aircraft that are heading our way. But we  
e start thinking about what we're going to do to counter them.  
e And then the second half of the scenario is primarily  
e dealing with beyond visual range intercept kinds of  
e activities and how voice might interact with that. Your  
e aircraft, being the newest and greatest fighter we have, has  
e anti-radiation missiles, long- and short-range air-to-air  
e missiles, ECM, chaff, and flares. It also has onboard  
e systems that will help you plan attack geometries, give  
e targets assignments, reroute planning if you want to go  
e around a threat. This mission begins with you as a flight  
e leader of a two-ship descending through five thousand feet  
e at point eight five Mach in instrument conditions. Your  
e wingman's in trail, maintaining his position via data-linked  
e information between your aircraft. You as a flight lead are  
e responsible for accomplishing the preplanned rendezvous with  
e the two attack aircraft, which are also aware of your  
e position via data-link. This is the display that you get.  
e When more information is available on the rendezvous, the  
e onboard systems might say:  
v Rendezvous data.  
e All you need to do to get more information is to acknowledge  
e it in some way. So with this situation prior to the  
e rendezvous, what things would you be thinking about?  
c Range and bearing wingman.  
e Using that command, we know what you want to find out.  
e And when you ask that question, the machine responds:  
v Sabre 41 at 14 miles, closing.  
e It responds with that kind of information. Give us an  
e evaluation here at this point on how you see the voice  
e interaction here affecting the speed at which you can get  
e that information.  
p Very good. I have no conflict with anything else, that's  
p exactly what I need when I'm flying instruments, and I find  
p it all down the right side all the way down there.



s 1.3.2  
e As you're continuing on the route prior to the rendezvous,  
e your aircraft receives another data-linked message  
e concerning this discovery of a new threat down range.  
v Threat data.  
e State your concerns and your intentions.  
o Threat locked onto me?  
p I'm asking it.  
e So that's your command? You're asking if that's true?  
e Any other kinds of situation, bits of information that  
e you're thinking about?  
p Well, I'm thinking about evasive action possibly, so I would  
p wait to hear the response first, and then...  
o Evasive course.  
o Give me a course where I can evade this missile.  
e So your command for 1.3.2 is "Evasive course?"  
p Correct.  
e How would it affect the speed of acquiring that information?  
p Speed would be very good; the conflict with anything else,  
p again, in the very good column. Workload, usefulness, right  
p on down the line. I don't have to do anything but ask the  
p integrated system.  
e When you ask for that information, you get this response:  
v Tracking J band.  
e It tells you that it is in fact tracking you, and gives you  
e a little added information on the band that it's using.

s 1.4.1  
e And we're interested now in what you're thinking about.  
c Jam.  
p I'm instructing it to jam, and:  
o Evasive course.  
e Your commands are "Jam" and "Evasive course;" so what you  
e want to do is counter the threat, and if you can't do that,  
e circumnavigate it.  
p Correct.  
e Please let me know if I put words into your mouth. What we  
e need to do is separate a little bit, get more verbiage from  
e you on describing your situation. What we're trying to do  
e is get these commands and establish the context of your  
e comments.  
p I'm giving you the commands first, do you want me to talk  
p about it, and then give you what I want to say?  
e Yeah, your situation and then the things that you're  
e concerned about. That is, what your focus of attention is,  
e and then what it is that you're trying to accomplish.  
p Alright, then let me just backtrack a little bit. With that  
p information in mind, my main concern is let me neutralize  
p that threat if I can with onboard ECM, and then I want to  
p know what my option is for evasive course, considering fuel,  
p time, distance, everything the smart system knows. I may or  
p may not choose, depending on follow-on information, whether

p to take that evasive course.  
e We need you to evaluate being able to use voice to get that  
e information for this one.  
p Again, the speed of it is excellent. I don't have a  
p conflict with anything I can perceive in the cockpit.  
p It does decrease my workload rather than interpreting  
p several RWR indications or looking at the heading, time,  
p distance, all that on my map, etc. And, obviously, it's  
p very useful.  
e When you asked for the jam, in our scenario we bring up a  
e display of the different kinds of countermeasures you have  
e available, to give you a little bit more control over what  
e happens. It would not necessarily have to happen this way,  
e but this is just the way we put it together. This shows  
e your ECM capability and that you have chaff and flares on  
e board. And then if you were to want to specify what kind of  
e countermeasures you wanted active, you could command that as  
e opposed to just saying "Jam"; you could also ask for chaff  
e or flares.

s 1.4.3

e How would you activate your countermeasures?

p If I wanted flares, I'd say:

o Flare.

p If I wanted chaff, I'd say:

c Chaff.

p If I want the pod to go off, I'll say:

c Jam.

e How do you evaluate being able to do that with voice as  
e opposed to the way we do it now?

p I'd say instead of very good, it's good. I don't perceive a  
p conflict with anything. And workload, usefulness, right on  
p down the good side. I don't think it's exponentially better  
p than switchologies.

e That's what we're looking for, sensitive evaluations. When  
e we wrote this, we had you ask for:

v ECM and chaff selected; threat no factor.

e And that might be the display that you'd get to let you know  
e what was active.

p So I'm interpreting that I have jammed the threat;

p therefore, the threat is no factor now.

e And that's in fact what happens.

s 1.5.2

e You're following on down the route of flight there and  
e reaching the point of the rendezvous.

v Rendezvous data.

e Onboard systems tell you there's a little bit more  
e information available if you're concerned. What kinds of  
e things would you be thinking about now that you're jamming  
e the threat; you're coming to the rendezvous point, and  
e things are just about to come together?

p I want to get tallyhos now, so I know everybody's starting  
p off together in visual environment, so I might ask for range  
p and bearing again. My wingman first, to make sure we're a  
p cohesive unit, and then to the other friendlies.  
e OK, what kind of words would you use to do that?  
o Range and bearing wingman.  
c Range and bearing strikers.  
e Please evaluate being able to use voice to get that info.  
p I'd have to say it's very good. Rather than having to  
p interpret air-to-air TACAN and/or hold down or anything I've  
p conventionally used to get that immediately while I could  
p concentrate on clearing my flight path in a low altitude  
p environment and picking up any other threats, etc. That's  
p an excellent way to do it, therefore, it's no conflict.  
p Very good all the way down the line here because it  
p decreases my workload substantially, and, obviously, it's  
p the type of information I want for usefulness.  
e When you asked for that, here's what you get. It gives you  
e visual feedback with some information printed, but since  
e it's not a real high priority bit of information, it doesn't  
e tell you that verbally. What we're trying to do is to limit  
e the verbal output from the system to very high priority  
e kinds of information, so we don't get the thing that some  
e people don't like now, which is too much talk in the  
e cockpit.

s 1.5.5

e Your rendezvous is complete now, and your flight is  
e escorting the attackers. This is the formation that was  
e prebriefed, sort of a pathfinder kind of a situation.  
p Where's my wingman in this?  
e He's in trail with you, he's the green number two. This is  
e you, this is your wingman, and the two strikers are in trail  
e with you. As you get closer to the FEBA now, your systems,  
e having been programmed for the tactics that you're using  
e that day, automatically cue you when it's time to do certain  
e things, like a fence check, for instance.  
v Consent for fence check.  
e What kind of a command would you use to tell the system to  
e go ahead and accomplish that?  
c Missiles armed.  
e You might verbalize for us a little bit the kinds of things  
e you'd be thinking about for this segment of the mission now  
e that you've joined up.  
p Looking at a full-up jet like I think I'm looking at, I want  
p to make sure any ID systems I have are set to go, I want to  
p confirm BVR capability. Obviously, all the missiles armed.  
p If it means cooling the AIM-9L's, that's implied with that  
p command. Or some type of super IR missile, tuned, same as  
p if they're AMRAAM or radar missile, that they're all tuned  
p as well. That all is implied with the word "arm."  
p And same thing with the gun, if I wanted to use the gun,

p that it's all ready set to go. All those things are implied  
p in the fence check. And I think I would like to have the  
p one word, or the two words, "missiles armed," mean all those  
p things I just said.  
e And as long as the system knows the kinds of things you're  
e thinking about, it can be programmed to do that. Let's  
e evaluate being able to command that with a voice command, to  
e get your fence check.  
p I'd say it's very good. Then again on the speed, that one  
p command gives me everything I need. I don't have to waste  
p time in the cockpit to check all those ID systems and  
p cooling and all the things I could possibly miss if I were  
p distracted. And, therefore, decreases the workload, and  
p enhances usefulness.  
e When you tell it to do that, "Missiles armed," you get:  
v Fence check complete.  
e It tells you that everything's A-OK, all systems are good.

s 1.6.1

e A little further in the mission, we're starting to  
e transition to the low altitude regime, down to 200 feet.  
e Your aircraft has a full TF capability; but for our  
e situation here we're asking you to check the equipment  
e status and then to check and make sure that the altitudes  
e have been set appropriately in the modes of operation for  
e terrain following radar. So in a transition from an  
e instrument condition down to a low altitude regime, what  
e kind of things would you be thinking about?  
p My main concern would obviously be avoiding hitting the  
p ground at that point, so I would probably set, with  
p conventional radar altimeter, an intermediate altitude in  
p there just to key me that, in case I did get distracted, I'm  
p going through a little safety buffer in there. I would be  
p mainly concerned with a smooth transition toward the  
p altitude at which I want to level off to get VMC. With a  
p smart system I would probably ask it to confirm that maybe  
p using the word:  
o Altitude safe.  
p All the other inputs that would start leveling me off  
p gradually would start to take over as I came through the  
p weather, and if I knew the weather was projected to be 800  
p feet or 700 feet, I would be looking to break out at about  
p that altitude.  
e What kind of a command might you give to do a status check?  
c Altitude safe.  
p An explanation would imply that I would have a smooth flyup,  
p I guess, for want of a better term. A smooth level off, not  
p a continued high rate of descent past a certain altitude to  
p make the transition.  
e Changes the scaling of how rapidly you descend?  
p Correct.  
e How about a quick evaluation of doing that with voice?

p I'd have to say it's only good, not very good. My main  
p concern at this point would obviously be the instruments, so  
p I think I could do probably just as good a job since most of  
p my attention would be diverted toward that for my own good.  
p I don't see a conflict with anything else, and workload, I  
p don't know if it could be substantially reduced. It  
p wouldn't be increased any, and, therefore, its usefulness, I  
p think, would be about the same as me doing that.  
e When you ask for that, here's a facsimile of a display we  
e came up with to show you that this radar was OK. The set  
e clearance plane is 200 feet; the altitude low warning is 100  
e feet.

s 1.6.3

e You can either select manual or auto TF, so how would you  
e like to do that?

p How would I select it? I would be manual at that point.

p I wouldn't trust the system to do that for me.

e In this cockpit, they're talking about either being able to  
e voice command it or possibly touch sensitive screen.

e Reach up there and touch it, or flip a switch.

p I would prefer to reach up and touch it as opposed to voice  
p command at this point.

e Can you tell me why?

p Just the familiarization I have of the smart airplanes like  
p the F-15. They don't always reliably work, and that's one  
p environment that the margin for error is just too critical  
p to me. It's not big enough to count on it, misinterpreting  
p my voice or not hearing it, so I would prefer to know by  
p physically touching that system and looking at the response  
p that I, in fact, had a good system.

e Why don't you give us an evaluation of using voice to  
e request manual.

p I would have to say that I would rather do it manually, so  
p I'd have to indicate poor right down the column there, for  
p that margin.

e That's what I'm looking for. In this situation, we have you  
e select auto.

v Auto.

s 2.1.2

e Cruising along here for at 200 feet, we have current threat  
e information on the horizontal situation display.

p Is that triple A?

e Yes, with the addition of having your flight actually show  
e up on the screen. As you're cruising along here with this  
e situation, a data-linked message comes into your aircraft,  
e telling you that there's a new threat and that there's more  
e information available.

v Threat data.

e Describe your situation, concerns, and intentions?

p My main concern right now is to determine the type of

p threat. And a voice command would be:  
c Threat status.  
p And I would expect to get something either audibly or  
p visibly telling me if that's an airborne threat, if it's  
p another SAM and what type of SAM it is, and what range and  
p bearing it is from me. All that with the two words I just  
p said.  
e Let's evaluate how you feel about being able to ask for that  
e information using voice, and then we'll go on and find out  
e what happens.  
p I'd have to say good all the way down the line. I think if  
p something were to pop up visually after it alerted me, I  
p could probably get the same information. It would be just  
p slightly better, though, than having the voice activation or  
p the voice warning prior to, because I might be looking  
p elsewhere. I might be looking out on my flight, and if I  
p heard that new information, that would key me to look back  
p at my scope. So it is better than just having it pop-up on  
p its own. So I would say good all the way down the line  
p there.  
e When you ask for threat status:  
v Helicopter 18 miles, 12 o'clock low, closing.  
e You get additional information, which is what you asked for.

s 2.1.4  
e For 2.1.4, with this information, can you describe your  
e situation, concerns, and intentions?  
p My main concern right now is: is it hostile, and what are  
p its capabilities to shoot me? Is it a troop carrier, or is  
p it armed with air-to-air missiles? Those are my main  
p concerns right now because my future decisions will be based  
p on whether to target it or evade it, that sort of thing.  
e What command would you use to find out that information?  
o Target ID.  
p With those two words I would ask for everything I just did.  
e What is it, if it's hostile, and what are its capabilities?  
e In the scenario here, instead of asking for that kind of  
e information since we're taking it as being hostile since  
e it's red here, we're asking you to go ahead and select an  
e air-to-air missile to get ready to fire. Prior intelligence  
e might have told you that helicopters in this area are air-  
e to-air capable. We're behind the FEBA, so what I'm asking  
e is if you could voice select an air-to-air missile, how  
e might you do that?  
c Missile arm.  
e Give me an evaluation of being able to do that with voice as  
e opposed to how you'd do it now in the F-15.  
p I'd have to say good because F-15 switchology is very good.  
p I've already fenced in, and in the case of where I would  
p normally fly, I'd have an AIM-7 selected anyway. I don't  
p see, again, a quantum leap in capability by being able to  
p select it cause I'm already thinking that way.

e When you ask for "Missile arm," here's what you get:  
v Master arm on.  
e On one of your other displays, you'd get this missile  
e display, which shows you that there's an air-to-air missile  
e selected, one's in standby, and it reconfirms that the  
e master arm is on.

s 2.1.6  
e Thinking of your situation now where you've just selected  
e your missile, and the helicopter's out there, closing on you,  
e probably at 15 miles now. What are you thinking about?  
p I'd like to know that he's in the envelope for me to shoot  
p him with the missile selected. If I know my own missile's  
p capability, or the system does, then it needs to let me know  
p if I've got that type of missile selected which is going to  
p be capable of taking that guy out. If not, I'll select  
p another missile. But I may not be able to shoot that guy  
p down with an AIM-7, so maybe I need to select an AIM-9. But  
p I need to know that. Now right now I have cues on the HUD  
p to tell me that, so a smart system would have to be able to  
p tell me that as well.  
e Min range, max range, optimum?  
p Or, in the envelope, period. Based on the target's  
p altitude, target's beam, target's ECM capabilities, all  
p those things determine whether I could shoot him or not.  
p Range alone isn't the entire factor, all the same things  
p that go into my little shoot cue on the HUD now need to be  
p processed, and give me a word back that lets me know without  
p having to look at a HUD that, hey, everything's solved. I  
p can shoot.  
e Thinking about the kinds of things you'll want to know, what  
e kind of a verbal command would you give to find that out?  
p Let me rephrase it: I'd like it to give me a verbal command.  
p "Shoot now." I've got everything I need. If I had to ask  
p it, then I would just say:  
o Clearance.  
e In this situation, how would you ask for a radar lock on  
e the target?  
c Lock.  
p Just like I have to do with a back seater.  
c Lock him.  
e Let's have you evaluate requesting a lock verbally.  
p I'd have to go with good all the way down, mainly because  
p the visual cues I can get right now that I'm locked are  
p pretty good, and I would save maybe just a little bit of  
p time having it do it for me, instead of going to an auto  
p mode that I'm capable of doing right now and then looking at  
p the visual cue that I got a lock.  
e When you ask for that lock, or when the system realizes that  
e the missile's within range, here's what happens:  
v Radar locked, in range, optimum five seconds.  
e It gives you verbal feedback about the best time to fire.

p That would be good. That was what I was trying to get at  
p earlier. That's what I'd really like.  
e We did this, though, to try to draw out the kinds of things  
e that you really want, instead of just giving them to you.  
p That's one of the most critical phases of air-to-air. When  
p it's pilot dependent on the visual cues on the HUD, we find  
p out a lot of times when you think you took a good shot, and  
p you come back and you review your film, you find out your  
p last visual cue was looking good but you didn't see the jam  
p cue. You didn't see the target going to the beam  
p momentarily, where the shoot cue disappeared momentarily.  
p Things like that. Whereas a verbal system that incorporated  
p all that and gave that status to you, I think would give you  
p a higher PK of making a good shot. So something that  
p updated itself in realtime. And when you had to shoot now  
p and you shot now, you'd have very little time lag if all  
p those solutions are being met. I think that could really  
p help quite a bit, especially on a maneuvering flight.  
e Do you have any concepts in your head of what a display,  
e an effective display for that purpose would be?  
p I don't think that's very good, because it takes too much  
p time and concentration looking at it. You don't need that  
p in a maneuvering fight. You're within parameters of  
p maneuvering engagement with current missile technology and  
p out of parameters within two seconds, and the time it would  
p take you to evaluate the sliding scales and go back and now  
p take action, you're out of parameters again. So, I would  
p prefer the way they do it now on the F-15 is the "lock  
p shoot" lights, which is good, except a lot of times your  
p attention is devoted elsewhere. Even though they're there,  
p you don't see them. If I'm making sense, they're good; it's  
p better than not having them. But I think, getting back in  
p the voice activated system, that would be a much better way  
p to do it. You hear things, it seems, more clearly than you  
p see things, sometimes, in the heat of battle.  
e So given that tiny window you have, what would be a verbal  
e cue from the system? You'd want it to say "shoot?"  
p "Shoot." That's right. Sometimes in the F-4, there was a  
p verbal cue; but that was one of the strong points of the F-4  
p that you had somebody else who had the time to QC the shot.  
p And while you were looking at your wingman or looking at the  
p guy's next move on you, whatever, now the analysis of  
p whether the shot was going to be good was taken care of by  
p somebody else in a command fashion through aural command,  
p which left no doubt that now you'd better shoot. Now  
p something that could be interpreted or misinterpreted is the  
p visual cue on the HUD.

s 2.2.2

e You shoot this radar missile and shoot the helicopter down.  
e But, of course, when you shoot this helicopter down, you've  
e just given away your position. So as you're cruising along,



e still at two hundred feet:  
v Threat data.  
e Threat radars come up. You get additional information on a  
e threat at twelve o'clock. An SA-18 which is a new SAM.  
p Somewhat as what I talked about earlier. Is he locked to  
p me, is he targeting me?  
e Would you give those commands, is that what you're saying?  
p No, right now, I'm talking about what my concerns are. Is  
p he really on? Is he looking at me? Is he ready to engage  
p me? That's what my concerns are.  
o Am I targeted?  
p or  
o Targeted.  
e Say whatever you're comfortable with saying. Don't assume  
e that this is a very constrained capability.  
o Am I targeted?  
e Yeah, whatever you want to say. Tell me what you think  
e about being able to ask for that information of whether or  
e not you're targeted, using voice.  
p I think it's good. And I'll tell you why rather than very  
p good: There is some symbology that can be put on RWR that  
p can tell me that, but it's not good enough yet. Where I  
p think a voice processing thing could say, "You are  
p targeted," then I'd know without a doubt what my next moves  
p have got to be. I've got to do something. But, right now,  
p with the RWR I've never flown with... I mean, you know,  
p overlapping audios... Is that enough for me to say I'm  
p really targeted? So I would say it's better to have a voice  
p system solve those problems for me and just come back and  
p say: "You're targeted."  
e However, you respond a lot more rapidly, maybe, with  
e somebody talking to you than all those buzzing audios.  
e Here's what happens:  
v ECM ineffective, reroute available.  
p My system jammed it?  
e No, that said "ineffective." The ECM onboard is not capable  
e of jamming this new threat. So the onboard system, the  
e tactics guy, says "Maybe we ought to go around this SA-18."  
p Let me just make a comment on that. I wouldn't even come  
p out with "ECM ineffective," because I just misinterpreted  
p that right then and there. If it wasn't effective, I'll  
p know that by the very fact that the system says "Reroute"  
p and then comes up with the reroute. Because if he can  
p neutralize it, then I don't have to worry about taking a new  
p route, so there's less time for confusion or anything else.  
e This is the issue that's very interesting in this whole  
e problem: the confidence in the systems. What do you need  
e to be confident in the fact that the reroute was made in  
e some logical sequence?  
p I guess I would have to know prior to taking the mission,  
p you know, with equipment study, etc and threat study that it  
p knows the projected max range engagement capabilities, and

p it will take me clear of that envelope. Now whether that  
p comes up as well with a visual depiction, and now I can see  
p that I'm going to be outside the envelope, that would be  
p nice, to give me additional confidence.  
e As far as your comment in that you did not want to hear that  
e the ECM is ineffective, from your point of view its implied  
e when it announced a reroute.  
p I would just personally not use that term. I obviously  
p misinterpreted it. I thought it said: "ECM effective,  
p reroute available." I'm thinking, in that very case, "well,  
p I don't want to reroute." That'll cost me more fuel and  
p everything. You could use a different term. I just say,  
p maybe the way the computer voice came through, it didn't  
p come out to me that it was "ineffective."  
e Yeah, but also you said that there's no sense in your being  
e presented with information that's of no use to you.  
p Well, I just say that's an option. It could've told me  
p "You're still targeted. Reroute available." I know I'm  
p still targeted. I thought it was a poor choice of words.  
p The "ineffective" and "effective" are too close together.  
p It would imply a whole different spectrum of events to me,  
p you know, one way or the other.

s 2.2.4

e Realizing that it just told you to do a reroute, what kind  
e of a word command would you do to request some more info?  
c Threat status.  
p My rationale is: I want to know, first of all, when I take  
p the new route, is he dropping me? The threat status would  
p imply I'm no longer targeted, drop the symbol, etc. Now I  
p know the reroute is effective, that's my main concern right  
p now. Is the reroute taking me outside this guy's engagement  
p arena?  
e Let's have you evaluate that.  
p In that sense, I think it's very good, because by the simple  
p verbal command, by "threat status..." Hopefully, the answer  
p I'm going to get is: "You're not targeted now." I don't  
p have to do the mental gymnastics of saying "OK, gee, maybe  
p I'd better check another twenty degrees right. Now how much  
p more fuel is that going to take me away from my target?"  
p I'll know just from that it's good. "Fine, I'll stay with  
p this." So I think it's very good.  
e Here it shows you what the reroute is going to look like if  
e you, in fact, take it to the right. It shows you that you  
e have to accelerate to 510, and that it takes into account  
e the additional fuel for mission planning.  
p Let me ask you a question. Now when you say "takes that  
p into account..."  
e It's supposedly going to keep track of your fuel, making  
e sure that you have enough bingo fuel.  
p I'm really putting myself in this scenario. We may be doing  
p this a lot of times in there, and I always want to retain

p the option of knowing when I have to go through SAM's and  
p say I can't reroute anymore, and get to the target and/or  
p get back. So I would like to be able to have a verbal  
p command that says "fuel cost" and have the guy give me a  
p number in minutes, of fuel available that...we always build  
p a buffer in missions. We always have whatever you want to  
p call it, from your joker to your bingo, and you can compute  
p that in minutes of fuel if you want.  
e Or it could come up in pounds.  
p Minutes would probably make more sense to me. And I would  
p like what I started with in that buffer and have it work  
p down. Everytime I ask for:  
o Fuel cost.  
p It's the cumulative reduction, and now I know, maybe,  
p two-thirds of the way into the mission I'm down to five  
p minutes of fuel buffer left. It would make a big difference  
p to me whether I took a reroute or not.

s 2.2.6

e We have you in this situation to get some more vocabulary.  
e Transmit this information to your wingman, realizing that in  
e a lot of systems it might do this automatically, that there  
e might be situations when information isn't shared between  
e cockpits unless you direct it to be. So if you could think  
e about a voice command that you would use to send information  
e from your cockpit to your wingman's cockpit.  
p I'd want it to be concise yet clear what I was doing. I  
p wouldn't want it to be misinterpreted that I was making a  
p break or anything of that nature. That it was a preplanned  
p move to avoid a threat, and I would just come up, probably,  
p with two words:  
c Route right.  
p Meaning "Hey, I'm coming off the route to the right." He  
p knows it's not going to be more, probably, than 90 degrees,  
p or I'm going defensive. So he knows I'm doing, basically, a  
p check away from the route for all the reasons I would  
p normally do that, which are probably to avoid a threat...  
p And the rest of the package would know that as well.  
e I guess one thing that was implicit in our thinking when we  
e put this together was that you and the wingman have the same  
e kinds of displays, but you're the lead. What we're saying  
e is that you're the one that sees these options; this is not  
e happening on the wingman's screen, and he's not going to  
e know about it until you deliberately have it sent to him.  
e Once you've made your choice, that's when it gets sent to  
e the wingman. Was it clear what our thinking was on that?  
p Well, I thought I was trying to say "How do I convey this  
p information to the wingman?" That's what I just did. I  
p think it's something that would be simple enough, we could  
p even talk about it before we left the ground.  
e To your computer, "Route right" should mean that it should  
e pass to your wingman, from computer to computer?

p That's right.  
e Instead of a vocal link now we have a computer link.  
p Sure, that I've accepted the rerouting option, and that's  
p what we're doing. Or it could be route left if we have to  
p go around the left side.  
e How about a quick evaluation of being able to transmit that  
e information?  
p I'm going to say same on this one, and the reason why is, a  
p good wingman is going to do what I do. He's going to be in  
p position no matter what, so the very fact that I'm telling  
p him that I'm doing it for a specific reason isn't that  
p critical to his actions. So I don't see any decrease or  
p increase in capabilities based on this. I mean, it's sort  
p of nice to know, you know, but if he's got the threat  
p presentation that I've got, he's probably going to figure  
p that I avoided the threat, and he's going to be there  
p anyway. He doesn't have the option of going off on his own.

s 3.1.2  
e You're on the rerouted segment of the low level when you  
e receive a JTIDS update on a new threat that exists, air-  
e to-air. You've already requested threat status on the  
e threat, and your horizontal situation display has  
e automatically changed scale to show the four possible  
e bandits out there, with their direction, speed and altitude.  
e Your aircraft is still set up for countering low altitude  
e threats. For 3.1.2, how would your situation description  
e now change? What would your concerns and intentions be?  
p My main concern, again, is going to be: do these guys  
p really pose a threat to me? Just because they happen to be  
p on a heading crossing angle toward my route of flight  
p doesn't necessarily imply that they see me or that they're  
p targeted toward me; so that's what I've got to assess.  
p That's what's going through my mind right now. If I look at  
p their range at 200 miles, that doesn't mean anything. I  
p mean, they could make a check turn thirty degrees right and  
p never even be a factor. So if there was some way in a smart  
p airplane through JTIDS or other esoteric systems that we can  
p guess at right now that they could tell me that I was  
p targeted, that's what I want to know. That way, I know  
p whether to engage or to evade or whatever. Those are my  
p concerns right now, and I lead that into what I know you're  
p expecting. The way I'm thinking now, what my verbal command  
p would be:  
o Am I targeted?  
p And I know the magic systems would probably weigh all these  
p things and figure out that I am or I'm not.  
e For the situation here, we're asking you to think about what  
e kind of a command you would give to reprogram your displays  
e in your cockpit from an air-to-ground, low altitude regime  
e to an air-to-air regime. You might have been looking at a  
e terrain following radar display, and then maybe an ECM.

p the option of knowing when I have to go through SAM's and  
p say I can't reroute anymore, and get to the target and/or  
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p number in minutes, of fuel available that...we always build  
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p call it, from your joker to your bingo, and you can compute  
p that in minutes of fuel if you want.  
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e in your cockpit from an air-to-ground, low altitude regime  
e to an air-to-air regime. You might have been looking at a  
e terrain following radar display, and then maybe an FCM.

p The simplest thing for me is I would say:  
c Air-to-air.  
e That's what I figured, but I couldn't say that. Let me get  
e you to evaluate though how beneficial that might be to be  
e able to reconfigure using voice.  
p I think it'd be very good.  
e As opposed to changing things.  
p ...Reasons why I say it would be very good all the way down  
p the line is I don't have to have the workload that I would  
p currently if I were in the F-15 air-to-ground mode, which I  
p hope I'm never in; but in any airplane when I'm doing that.  
p To change the displays with one word would save me a lot of  
p work in the cockpit.  
e That's right.  
v Configured air-to-air.  
e Gives you a little bit of feedback there. It really did it.  
e What it did here is it turned off the TF radar. It turned  
e off your radar altimeter, remoded the radar, changed your  
e horizontal situation displays for scales and things like  
e that to give you air-to-air symbologies. Maybe even your  
e HUD symbologies might have changed from a TF to an air-to-  
e air.  
p I would also expect, while we're discussing here, that it  
p would prioritize my ECM pod to jam air-to-air threats and  
p not air-to-ground threats.

s 3.1.4  
e We're starting our climb out here from low altitude to a  
e high altitude situation. What kind of things are you  
e starting to think about now other than what we talked about  
e with "are you targeted?" I'm going to ask you to do another  
e thing you probably wouldn't do yet. Anything you want to  
e add here before I continue?  
p Yeah, mainly, I need to know that information first, because  
p all my other actions are predicated on that. To do my job  
p successfully, I don't necessarily have to engage. And I  
p would choose not to engage if they weren't a threat so I  
p could go further down the line with the guys I'm trying to  
p get to the target. Assuming, for the sake of discussion,  
p that I'm going to have to engage these guys, the thing that  
p comes most to mind now is I need to build SA on the part of  
p my wingman, because we want to employ our fire power to the  
p best effect. So I want to make sure that he's aware of  
p what's coming our way; so we can start talking about who's  
p engaging who, and who the nearest priority targets are.  
p Those are things that are all going through my mind right  
p now, based on the fact that we're going to have to engage  
p these guys.  
e We're looking for you to request again to set up the long  
e range, air-to-air missiles. What would you command?  
c Long range missile.  
e Pretty direct. Why don't you give me a quick evaluation of

e how that would be compare to what you do now in the F-15?  
p I would say poor. And the reason being is a simple thumb  
p switch...tells me everything I've got.  
e You're lucky.  
p That's right; it makes all the difference. I don't need  
p anything else. I always know where I am. It's called a dog  
p fight switch for selecting long range, short range or gun.  
e Your command is carried out, and you get your missiles.  
v Master arm on.  
e ...Gives you a pictorial display of that.

s 3.1.6

e We have a new sensor. It's actually an old sensor that  
e they're resurrecting. It's the infrared search and track  
e that allows you to get azimuth and elevation information.  
p Passively?  
e Yeah, very long range and passive. So if you were able to  
e have that kind of sensor capability, how might you...  
p Ask for it?  
c Heat track.  
e "Heat track," as opposed to "Radar track."  
p I'd say good, because I'd have to believe that if I had that  
p switch in the F-15 it would probably take minimal effort.  
p Not having a switch, I would say it's OK to do it verbally.  
p So I'd have to give it a good all the way down.  
e Here's what our display might look like: Shows you that  
e there are four heat targets at twenty left and twenty high.

s 3.2.1

e Now we'll ask if they are hostile or not. good guy, bad guy  
e information, whether IFF or JTIDS information.  
p How would I ask for it?  
e Yes.  
c Target ID.  
p I think "Target ID" would be very good in the sense that I  
p wouldn't have to wait for some visual signal to come back up  
p and initiate a mechanical interrogation. It'd be there.  
v Hostile.  
e There it gives you feedback immediately, in color and voice.

s 3.2.3

e TheIRST would probably have two fields of view: a wide  
e field of view, which it's in right now; or you might be able  
e to ask for a narrow field of view, which is a magnified or  
e expanded picture of a certain area centered around the heat  
e sources. If you could request to change the mode of the  
eIRST, what might you say?  
p Narrow or wide?  
c Narrow.  
e When you ask for "Narrow," for 3.2.3 it shows you the narrow  
e field of view and gives you more definition on the targets.  
e You can see there are actually four. It might break others



e out, if there were others superimposed on each other. It  
e zooms in for a closer look. Please evaluate being able to do  
e that with voice.  
p OK, I think it would be good just because it would be less  
p complicated to change modes verbally than manually,  
p especially if I'm doing something else.

s 3.2.5

e OK, the onboard systems also have a capability of showing  
e you what the projected track of the targets might be, based  
e on historical data: where the airplanes have come from and  
e where they're headed for a certain period of time...to give  
e you more information on attack geometries. All you have to  
e do is request...

c Target track.

e OK.

p I think that would be very good because right now...first of  
p all, I've not seen the system yet.

e Yeah, I know.

p But it's simple saying "target track" and being given the  
p track, so I think it'd be very good, a good quantum leap.

v In range for air-to-air radar.

e System tells you when you're coming within range for the  
e air-to-air radar, realizing that you started out at two  
e hundred miles. Now you're getting into maybe a hundred and  
e fifty, but it doesn't matter.... Whatever the radar  
e capability is at the time, it would tell you when you're in  
e range for air-to-air radar.

s 3.2.7

e So for 3.2.7, what kind of things now are you starting to  
e think about now that you're in range and you know a little  
e bit more about the threat?

p Well, I know what their track is, but I would still like to  
p know if they are targeted against me. I'm starting to  
p deduce that they probably are because I can look at their  
p heading crossing angle toward me and see they're setting up  
p intercept geometry. However, the things I'm starting to  
p think -- assuming that right now I always have to be  
p conservative -- are: When do I want to target them? How do  
p I want to employ? So, I have to think about when I'm going  
p to upgrade to radar track from passive detection. Looking  
p at the tactical environment, he just gave me range  
p information. That's important to me. When he just told me  
p that, it's real important; so, I would still be passive. I  
p don't want to emit at this point.

e Yeah, you don't want to be detected.

p But we'll say my airplane in the future has a radar range of  
p 100 to 120. OK, there's no need for me to give away my  
p position yet. So that was real vital information. I would  
p just continue to track passively; but I'd be prepared to ask  
p for radar track. And that's how I would ask for it:

c Radar track.  
e So when you ask for the air-to-air radar, which you just did  
e for 3.2.7, as opposed to having to turn it on manually, how  
e would you evaluate being able to use voice?  
p Very good. Again, much less workload in the cockpit; plus  
p it gives me information now. I don't have to fumble around.  
p I can still be interpreting what's going on and ask for that  
p information in the process.  
e We came up with B-scope display to show you the targets out  
e there at about 100 miles. It's in a track while scan mode.

s 3.2.9  
e What things are you starting to think about at 3.2.9, now  
e that they're on the radar and you have more information?  
p Targeting between myself and my wingman; who the nearest  
p threat is; and that's the guy we want to target first.  
p He's still a little far out, so I'm not ready to target yet.  
p I'm still going to be in the watch mode.  
e We're stretching the capability here. We're trying to move  
e all the things we do closer in now, out farther and farther,  
e just because equipment is going to be better in the future.  
p Well, if I had to put a number on it, if I could shoot  
p somebody at forty miles, OK. So right now I would want my  
p wingman to know his target; and if we can extrapolate even  
p further, maybe we could multiple target. If we do multiple  
p target, then we sure want to know who's doing what to whom  
p right now, so we can get that out of the way. Right now I  
p would need to convey to my wingman who I want him to target.  
e The next thing here at 3.2.9 is that we're asking you to  
e utilize some of the onboard management capabilities. The  
e onboard systems can take into account the environment,  
e attack geometry, altitudes, capabilities of the missiles,  
e how many they are against how many you are, and come up  
e with different kinds of intercept options, whether it be a  
e nose-on or single-sided or a pincer. It'll give you what it  
e feels are the options available. All you have to do is to  
e request it, and it will give you a chance to select the one  
e that you want.  
p You're asking me now, I know, how would I ask it to tell me  
p all that stuff? I'd very simply just say:  
c Targeting option.  
e When you did that, it'd show you a couple of options. Let's  
e have you rate the capability of being able to ask for that  
e verbally before we go on.  
p You don't have an outstanding category. That is probably  
p the single most difficult feat to perform in an element,  
p even in the F-15. Based on the dynamics and the fluidity of  
p the situation, and the wingman's position, and perceived  
p intentions of the bandits, and all the changing dynamics of  
p speed, and figuring out the best option... That's the lesson  
p that most often gets hit when we get back to debriefing:  
p "Gee, that attack geometry really wasn't what I wanted; it

p didn't work out right." If I had a really smart system that  
p could process all those factors at light speed and give me  
p the best option, it'd be a quantum leap forward.  
e I'm not saying that it's there, but it could be there.  
e Your aircraft reports two possible attack options and  
e displays them to you.

s 3.2.11

e The numbers associated with them are priority numbers.  
e Number one option is a shorter time to engage, but it has a  
e lower PK, while number two is more conservative but it  
e offers a much higher PK. So based on that information, what  
e are you thinking about and what are your intentions?  
p Let's go back to the mission again: The mission, as we're  
p pressing on down the road, is not for me to kill anybody as  
p much as to get the strikers on and off target. That has to  
p be paramount. So, I'll have to assess in my mind where I  
p am, how much fuel we've got left. That's probably the  
p single driving factor here. What did we have to do?  
p How many reroutes did we get? What was the effect on this  
p fuel cost thing that I came up with? That may drive exactly  
p what option I have. I may not be able to go for option two.  
p I may have to take option one. How many missiles do I have  
p left? What type? Assuming that maybe some missiles are not  
p optimized for a particular type of geometry. So those  
p factors are going through my mind. That will influence my  
p determination of which option I take; and it isn't always  
p going to be the one that has the highest PK. It also may  
p include these guys' intentions. If they're basically hit  
p and run...if I knew from threat tactics that they weren't  
p going to hang around, maybe one shot fired immediately would  
p dissuade them; that's all I really want to do. I certainly  
p want the higher PK to get a kill; and I want to keep them  
p away from my guys to protect them.  
e What kind of a command would you like to give to request one  
e of those two options?  
c Target option one.  
p Or two, whatever the case may be.  
e And when you did that, it would come up with that option.  
e How would you evaluate that?  
p Being able to select that option by voice and have it put  
p into the computer, as opposed to doing it the way I do now,  
p is outstanding, again, for the reasons I just enumerated.  
e Just to get more information out of this scenario, we take  
e option two, to make it a little longer and get more info.  
p That may not be a bad option even though you say it may take  
p a little longer. It may pull the bandits away from the  
p intended route flight of the strikers.  
e Yeah, here in the scenario, we tried to show that you're  
e between the enemy and the strikers, so dragging yourself out  
e in front of the attackers might dissuade them from going on  
e to the airfield

s 3.2.13  
e You get option two selected, and we're going to ask you here  
e to give us a command that would transmit this change in plan  
e to your wingman, realizing that he didn't have the options  
e come up on his display.  
p OK, but let me ask you, if I come up with a verbal command  
p that will make my system talk to his system, then your  
p system will send all this information to his system?  
e Sure.  
c Wingman target option two.  
e And please rate that compared with what you'd have to do  
e today to do that?  
p Well, I'd have to show it as very good again, because of  
p what it would've taken me to tell him exactly that. You  
p know, in simplistic terms, I'd have to say, "Jazz single  
p side offset," or something like that. But it would still  
p take more communication, which makes us susceptible for  
p jamming, etc. Now if I could pass him the geometry  
p visually, it lets him know exactly what we're doing.  
e That's where data-link's going to be nice, to share that  
e information.  
v Message sent.  
p One of the things I consider real important is that the  
p message was received, not just that it was sent. If I don't  
p get acknowledgement so I know we're not being jammed, then  
p all that other stuff was a moot point, you know.  
e Our thinking was when we had these acknowledgements that  
e says "Message sent"....  
p That it implies that his system received it?  
e Right.  
p ...Maybe a different word, then, for the purpose that it was  
p received maybe "Message confirmed." "Sent" still implies to  
p me that it went out; but I don't know if he got it.

s 3.2.15  
e We're starting to become pretty committed to this air-to-air  
e intercept, and it was nice to hear that you were still  
e concerned about the attackers. Let's do a formal request of  
e what their position is and what their activity is. If you  
e were able to query a system to find out what the other  
e element's situation was, what command might you give to find  
e out what Sabre flight's condition is for 3.2.15?  
c Status strikers.  
e "Status strikers." See what you think about this info:  
v IP inbound.  
p That's fine.  
e That gives you enough? Let's you know what they're doing?  
e Let's evaluate that, being able to go "Status strikers" and  
e find out what their position is as opposed to what you'd  
e have to do today.  
p Very good because it let me know their geographic position.  
p I'm assuming that they had not been dragged away from their

p route, engaged by somebody else. That's important to me  
p because I can determine in this particular case if I should  
p stay tied up with these bandits. Or maybe I want this to be  
p a minimal time engagement. As soon as they're no threat to  
p me, then, hey, I'm getting out of here. And I'll try to  
p rendezvous with the strikers on their egress route.

s 3.3.1

e Realizing that the attackers are now off on their own, doing  
e their ingress, we're back to the BVR intercept, thinking  
e about your cockpit. With this display here, what are you  
e starting to think about as we try to intercept the pathway  
e in the display there? What concerns do you have?

p Well, I'm a firm believer in the philosophy that I need to  
p shoot first. I already know they're hostile by the red up  
p there, so I'm not worried about an ID now. I need to know  
p if they are targeting me, because I will fire out of range  
p with a missile first to dictate the character of the fight.  
p I'll use one to do that, so if they're not targeting me, by  
p whatever this magic system knows, then I'll wait and drive  
p in closer, so that when I take my shot, it's going to be a  
p higher PK shot, and destroy somebody. So, I need to know if  
p I'm being targeted.

e I don't tell you that yet. We ask you to request some  
e intercept vectors to put you on the pathway. Sort of like  
e requesting some GCI, but not outside your airplanes.

p How would I ask for that?

c Snap target.

e That would give you a heading to the target.

p It would imply to me just what a snap vector does now:  
p the quickest thing to get to effect an intercept -- not as  
p pure pursuit but the quickest.

e Let's get a quick evaluation on asking for "snap."

p I think it's good. I say good over very good, because I  
p think if I had the depiction of target track, which I can  
p get currently with systems that are available now, I can  
p pretty well determine if I'm in the position I want to be.  
p So it's something nice to have in the event I had to beam  
p off or do something different. Now I want a quick refresher  
p of the quickest hot vector to get intercept geometry going,  
p rather than go through a few more mental things. It's not  
p very good because I've got some pretty good information now  
p that I can use. This is just a little bit quicker, and I  
p can get it when I want it.

e OK, when you ask for that, we give you a snap vector of:

v Vector zero six zero.

s 3.3.3

e We're closing now on the stern conversion. If you were  
e wanting your wingman to go to his attack position, what  
e would your command be for 3.3.3?

o Wingman attack.

e Where we use "deploy" now, right?  
p Yeah, I misinterpreted what you're saying here.  
e OK, I was trying not to give it away.  
p And when you said "his attack position," I'm assuming he's  
p already deployed right now, when we started this. We  
p wouldn't be in that position with him doing anything but  
p being in an attack formation.  
e So we're going to deploy the wingman. What would you say?  
p What I've always said, which was:  
c Deploy.  
e Yeah, why change the word now when everybody knows it.  
p I don't see any savings over what we already do now.  
p It means the same thing, it takes the same amount of time.  
v Message sent.  
e "Message confirmed," eh?

s 4.1.2  
e We're getting closer in; we're within fifty miles or so,  
e passing the three-nine line. Your aircraft has systems that  
e can help determine the optimum target assignment, based on  
e geometries or whatever tactics you can put into the system,  
e and it will give you this information; all you need to do is  
e request it.  
v Target assignment ready.  
e Before you do that, why don't you talk about the kinds of  
e things you'd be thinking about and your concerns and  
e intentions with this kind of a situation.  
p Well, big thing is that, again, between myself and my  
p wingman that we don't shoot the same guys. That we want to  
p employ fire power to its maximum here. So that whatever we  
p come up with, that game plan is what we're staying with when  
p we come up with it; so he doesn't do something that he  
p thinks he's supposed to do after I'm doing something and we  
p shoot the same guys. That's just background; but that's  
p real important in my mind; we've got to prioritize our  
p weapons, and optimize them. So picking different targets is  
p very important. The next thing is, do we have the geometry  
p that will allow us individually to optimize our PK of our  
p weapons? I'm not worried about being shot at now, unless  
p they develop rearward shooting missiles in the future. I  
p feel I'm not invulnerable to being attacked because I've  
p swung a wingline on these guys; so I want a quick, hopefully  
p unobserved, undetected, minimum time attack. And optimum  
p weapons firing for myself and my wingman.  
e Let's see what the system has for the assignments.  
p How I would ask it?  
c Assign target.  
e It would color code your targets in blue and your wingman's  
e in another color, and it also gives numbers to them.  
p And it took into account all the things I just said?  
e We pay enough for the systems; they ought to do all that!  
e How would you evaluate being able to ask for that?

p Well, let me ask you a question first, because I may be  
p asking something that you don't know the answer to right  
p here, but we should probably have already known that  
p information prior to the situation: How many times will  
p that change? Is there a point at which I say "this is it?"  
p We freeze it, in other words. "No matter what happens, ace,  
p these are your guys, and these are my guys." Because I can  
p foresee in this a real problem: Any target movement, any  
p range changes...because of the geometry, because of the  
p targets' actions, it reprograms and retargets. That's  
p getting away from the point a little bit, but that's real  
p important to me.  
e You have the ultimate decision. This machine's never going  
e to make those decisions for you. If that target assignment  
e moves on you or you are not happy with it, you can change it  
e and deliver it to your wingman.  
p I can imagine these assignments changing a couple of times a  
p second.  
e Yeah, you need to confirm these assignments or change them.  
p OK, so what you're asking me now is, assuming that that is  
p still valid for us, how much help was that? Over what we  
p have right now, I think, again, I'd say outstanding, based  
p on the problems we have out there now. So, I don't have any  
p problems saying very good all the way down the line.

s 4.1.4

e Now with that in mind, if you in fact agree with these  
e assignments and confirm them, we're looking for a voice  
e command that would transfer that information to the system  
e and your wingman.  
p What I would say is:  
c Attack confirmed.  
p Which would tell the system and my wingman, "That's the  
p plan, Jack; it doesn't change from here." Unless we cancel  
p the whole thing. So, a simple word command like that,  
p coupled with the display that I know he's gotten from my  
p initial targeting commands, we're clear in our minds who's  
p doing what to whom. So I think that's, again, a quantum  
p leap compared to explaining alot over the radio.  
e And we get a message confirming:  
v Message sent.

s 5.1.2

e And here's what happens: As you predicted, the enemy begins  
e to maneuver and appears to merge. And as we close within 35  
e miles, the onboard systems report...  
v Targets cross.  
e ...a target cross or a split; and displays it on the  
e situation display. Target one appears to be converging on  
e your flight while target two is attempting to separate  
e possibly towards the airfield to go after the attack flight.  
e For 5.1.2 how does this change your situation, your

e concerns, and your intentions?  
p Well, what I want to be able to do is be able to switch our  
p targeting, especially at that range, even projecting longer  
p range missiles. And I'd like a concise way of doing that.  
p Right now if that happens to me, and it's happened several  
p times, I need to be able to talk to the wingman, get his  
p radar, range permitting, or eye balls, if it's visually, and  
p say, "Target switched." And probably additional verbiage,  
p "You've got the trailer now," reference such-and-such a  
p heading. "I've got the leaders; I've got the guys headed  
p north, east, or whatever." So if I could just say, uh...  
c Targeting switch.  
c Target switch.  
p And the system would change so that the guys that are headed  
p toward him get a "2" and mine come up with a "1". Then his  
p system knows and he knows who has who to shoot now. So that  
p would be a tremendous advantage to be able to do that.  
e There, it has changed the color code and the numbers.  
p Do you want me to evaluate that? Yeah, that's very good.

s 5.1.4  
e And then here again, we ask you to request this information  
e be passed to your wingman.  
c Target switch wingman.  
p "Wingman" would imply "send that to him."  
e I want you to evaluate that for me so we can show how  
e important that might be: "Target switch wingman" for 5.1.4.  
p Again, minimal verbiage. You know, you get a lot across.  
e And it says "Message sent" which means "Message confirmed."  
v Message sent.

s 5.2.2  
e OK, as we get closer in, the onboard systems will give you  
e information about when:  
v Target in range in ten miles.  
e Any additional situation concerns here for 5.2.2?  
p What I'd be thinking about now is the status of my wingman's  
p targets. I sure know the status of mine, because I know  
p when I'm firing the missiles or not. What is my wingman  
p doing? Today out there, I'd be saying "status two." Two's  
p reply: "Engaged offensively, splash one, engage the other."  
p So that would be something I'd be considering right now.  
p What is his status, what's he doing?  
e You want an update on what his situation is?  
p Exactly. What are his bogeys doing; what is he doing to  
p them, hopefully? Has he broken off the engagement? Are  
p they defensive now? Are they dead? You know, and now I  
p know, hey, can I count on him coming with me, etc., etc.?  
p His status, and, therefore, his target's status to him, is  
p real important to me right now.  
e What would you say to get the status of your wingman, again?  
o Status wingman.



e In this scenario, we're going back and asking you to request  
e preparation for firing at two targets. If you could fire at  
e two targets, targeting two of them at once, what kind of a  
e command would you give?

p I really haven't had an airplane that I could do that in, so  
p I'd have to think about that for a second; but I wouldn't  
p want to say "launch two" because that might just imply  
p launching two missiles at the same guy.  
e They probably aren't going to let you do that with voice.  
e Probably going to make you pull the trigger.

p How about:

c Multiple launch.

e Get things set up for multiple launch as opposed to single,  
e with the word "multiple" keying it to separate targeting  
e missiles.

v Master arm on, radar locked, in range, optimum five seconds.  
e Bringing up two missiles ready to go instead of one.

p Well, and also implying missiles separately targeted,  
p assuming the system can do that in the future, versus  
p launching two at a single target.

e Can you evaluate that on 5.2.2 "Multiple launch?"

p Well, being able to do that would be pretty significant.

p And I'd have to say very good, again, to be able to call  
p that up without having to make any switchology changes.

p So I think it's very good.

s 5.2.4 and 5.3.1

e The aircraft onboard systems, again, told you that the  
e missiles were armed and that the targets were in range and  
e that the optimal launch would occur in five seconds. You  
e and your wingman fire the missiles, and each of you  
e immediately disengage. You cover your egress with chaff and  
e flares. Describe your situation, concerns and intentions.

p My main concern right now is for the status of my wingman.

p What's his position to me in range and bearing? Is he

p defensive. Is he clear the nearest bandit to him? If

p they're all going towards him, let's get back together away

p from the engagement zone. Now we can think about what else

p we want to do. Do we want to go toward the target area and

p cover the egress of strikers? But our immediate concern is

p to get back as an element. When we separately target and

p we're engaging, he is doing his thing, and I'm doing mine.

p We just happen to be pursuing the same objective. I would

p like to know what his total status is. Is he clear, is he

p still engaged, is he engaged defensively? What's his

p distance and range and bearing from me?

e And how would you command that?

c Status two.

p "Status wingman," what I used earlier, could be pre-attack  
p status. "Status two" could be a post-attack status. But I  
p want all those things I just talked about. So "status" is  
p still the big key word for me.

e ...Requesting join up information. You could interpret that  
e as being similar to what you asked.  
p I asked that plus a little bit more. So I would have to  
p rate that as very good for the same reason. I don't have to  
p interpret air-to-air TACAN and AI interpretation, etc.  
p It'll give me that with a verbal command.  
e Over here on that page you just flipped from, we wanted to  
e get a vocabulary again for dispensing chaff and flares,  
e using voice, and how you felt about doing that.  
c Flares.  
c Chaff.  
e How would you evaluate that?  
p I can do the same thing and not expend any more or less.  
e OK, and here's some feedback.  
v Dispensed chaff and flares.  
e Tells you that the chaff and flares are going out. Now to  
e address your "status two" command:  
v Wingman at nine o'clock, eight miles, line abreast.  
e Gives you information on where he is for the rejoin. And  
e then we go to a couple of different disjointed segments.

s 6.1.1

e After you rejoin with your wingman, you pause to assess the  
e air situation. And you request a status check, a battle  
e damage check. Just an after-engagement check on the  
e situation in your aircraft. What kind of vocabulary might  
e you use?  
c Ops check.  
e OK, that was for 6.1.1. And don't get angry with me, but  
e this is what we have:  
v Minimum RTB fuel; recover at alternate.  
e The system would have been updating you all along the way on  
e what the fuel is. We're just exercising something here that  
e might be able to give you additional information.

s 6.1.3

e Once it tells you you have min fuel, it could give you  
e additional information to help you out of this situation.  
p You ask me what I'd want for additional information?  
p Well, the first thing I'd want is the optimum profile to get  
p to the nearest suitable field. Now, the nearest suitable  
p field would be friendly, number one. If a base had been  
p overrun that week, e.g. Bitburg's no longer available, it  
p needs to know that, because, it needs to know where I really  
p can go now. And then I need to know if I can get there from  
p here; so an immediate computation from my present position  
p to the nearest suitable field in friendly hands that I can  
p land at. And I need the profile to get there: it needs to  
p give me the heading, the climb to altitude, and the schedule  
p for let down. And then, hopefully, I have a five-mile  
p final, assuming a straight-in type of approach, which you  
p probably ought to assume in most cases. So if I could call

p that up, that would be great! I'd say, "yeah, I can make  
p that" or "I'm going for it." Or, "no, I'm not getting home;  
p I'm going to get feet wet and get picked up." But that  
p would make my decision for me.  
e How would you request that?  
c Divert data.  
p If I could say "divert" and get that, that would be super  
p outstanding! It just would incorporate all the variables I  
p would certainly have to really do some gymnastics with. And  
p therefore save me fuel because I could get started on the  
p profile now.  
e Here's what we came up with:  
e And you could select one of those. Shows you that you make  
e all three of those, you need only select the one of your  
e choice.  
p Well, what do I do, select it?  
e Yeah.  
c Divert base two.  
e Nice to have a number for the ones that you can't pronounce.  
p That's right.  
p Well, at least I think a program, like I said, on a true  
p environment in Europe, for instance, where Ramstein might  
p not be available. It might be a new number three. You  
p could program that in, hopefully, on the day before, based  
p on the latest intel estimates or something. You want me to  
p grade that then here?  
v Message sent.  
e That passes a message to your wingman and base two, so they  
e know your intentions.  
p Or instead something says to wingy: "You're on your own."  
  
e Do you have any comments overall on the scenario?  
p Yeah, I think some of that stuff I really feel in my heart  
p could be done now. That would be my words to you all. If  
p you had any impact somewhere in Wright-Patt...is that in  
p particular the targeting options. Boy, if we could  
p incorporate that right now...  
e OK! Thank you very much for your help!!

End of Transcript - Subject 20

## APPENDIX H

### SUBJECT 51 - Biographical Data Form

Age (Years): 31  
Organization: 157 Tactical Fighter Squadron  
Full time/Part time: Part  
Occupation: Airline Pilot  
Squadron position: Squadron Weapons Officer  
Total flying hours: 2200  
Total jet hours: 2200  
Total years rated: 8

Specific Aircraft (type, hours): F-16, 700  
T-38, 1400  
T-37, 100

SUBJECT 51 - TRANSCRIPT

s 1.2.2  
e Mission begins with your two-ship of fighter aircraft  
e descending through 5000 feet and 0.85 mach in instrument  
e conditions. Your wingman is in trail, maintaining his  
e position via data-linked information between aircraft. You  
e as flight lead are responsible for accomplishing the  
e preplanned rendezvous of the two attack aircraft which are  
e also aware of your position. Here's you, your wingman, and  
e your aircraft comes across and says:  
v Rendezvous data.  
e Your aircraft tells you that. Given the information we've  
e given you so far, what are you thinking?  
p Oh, and that's what this depiction is?  
e This is what you see, where your wingman is.  
p What prompted the machine to say "Rendezvous data?"  
e A data-link coming into the machine. That it just found out  
e that they are coming up.  
p Oh, but it hasn't depicted the other guys?  
e Yeah, because you might be doing something; it just is  
e notifying you that it does have that information. Do you  
e want to see it, or do you not really care about it at this  
e point?  
p Oh, I see.  
e It's querying you, like: "Hey, I've got it; do you want it?"  
p Okay.  
e Okay, how would you access that?  
p How would I... You want a voice command to access?  
e Right.  
c Access.  
p I mean, I don't have a magic word.  
c Rendezvous data access.  
p or  
c Display.  
e Okay, so for 1.2.2, would you rate that there?  
p Rate rendezvous....?  
e If you had to get that information, evaluate being able to  
e use voice to get that information, compared to usual your  
e methods.  
p Okay, voice compared to usual methods. I would probably say  
p about the same. Rendezvousing, generally, isn't all that  
p high a task load. It'd be real similar to do a radio call  
p for the data. Conflict, I would say relatively no conflict;  
p so that would be very good because, again, my workload there  
p is rather small. Workload and usefulness... Yeah, more is  
p better.  
v Sabre 41 at 14 miles, closing.  
e That's what the aircraft tells you when you ask for the  
e detailed rendezvous data.  
p Okay.

s 1.3.2  
e At this point in the mission you're approaching rendezvous,  
e and your aircraft has received a data-linked message  
e concerning the discovery of new threats down range. Threat  
e information has come from satellite and JTIDS.  
p So I don't get to rate what it just told me?  
e No, we're rating only voice input; but we'd like your  
e thoughts on everything we present. What are you thinking  
e about?  
p What exactly did he just say?  
v Sabre forty-one at fourteen miles closing.  
p Okay, "forty-one" should be "four one." And "fourteen miles  
p closing"... "Closing" to me is a superfluous word if you can  
p see a visual depiction of an airplane's nose pointed at you.  
p And what I would rather hear on something like this is:  
p "Sabre four one, right for fourteen." Or, assuming we'd be  
p heading three six zero: "Sabre four one, one two zero,  
p fourteen." Either one of those would be adequate because  
p that keeps me aware of his bearing to me. And "miles"  
p should not be necessary because in fighter pilot talk you  
p always have bearing and you always have range; and the next  
p thing should always be altitude; and the next thing after  
p that should always be aspect angle. And F-15 and F-16 guys  
p should all talk the same way, that way, so.... Does that  
p make sense?  
e Perfect sense. That's the kind of stuff we need.  
e Now back to the threat data, here's what you get:  
v Threat data.  
e Your plane just shows you an SA-10 out there; and tells  
e there's "Threat data" now -- meaning it has more  
e information. What are you thinking about at this point?  
p Okay, this (the scenario handout) says: the aural cue  
p "Threat data" advises you a new threat has appeared and more  
p information is available upon request. Anytime the computer  
p says "Threat data," I know there is more information out  
p there if I want to call for it?  
e Right.  
p Again:  
c Display.  
p You guys may have a better word for it.  
e No, that's what we're trying to get from you. Words that  
e are going to be best for you; you're going to be the user.  
p "Display" comes to mind to me.  
e Okay, that's fine. Would you rate that?  
e We've heard everything from "Show me," "Go ahead," "Give it  
e to me,"... so we're apt to get a wide range from that.  
p If you could think of a one syllable word that would be  
p germane to this, that would be even better. And everything  
p that is the fewer syllables, the better. We try to do as  
p few syllables as possible, talking on the radio, and this  
p would be better. "Display" sounds good.  
e Okay, describe situation, concerns and intentions.

p I'm concerned about getting shot down. My intentions are to  
p find out more about that thing. I really can't compare it  
p to anything, because I've never flown an airplane that would  
p interrogate enemy radars and show me more stuff. So the  
p speed of the "display" command would be very good, and  
p conflict and workload should also be very good. Usefulness  
p is tremendous, because the type of systems you guys are  
p talking about we don't have and we desperately need.  
v Tracking J band.

s 1.4.1 and 1.4.3

e Now, the threat is real and must be dealt with; but you  
e would like to maintain heading until after rendezvous, if  
e possible. What are your concerns and intentions now?  
p Well, I think my desire to maintain a heading to effect a  
p rendezvous is not very critical, compared to the fact that  
p I've got an SA-10 twenty miles on the nose, because that is  
p right in the heart of the envelope. And I am also assuming  
p that number three and four here have JTIDS information about  
p where I am. I would want to give a command like:  
o Avoid... east.  
e Okay.  
p Again, I'm assuming I'm heading north here on the screen.  
o Avoid east.  
p And that would allow them cutoff on the rejoin.  
e Okay.  
p And for it to display a track for me to avoid the threat to  
p the east, if that were possible. So "avoid," "avoid east,"  
p or "avoid (some direction)."  
e Good. What we're going to do is counter with our onboard  
e countermeasures. So what we're looking for is a...  
c Jam ten, twelve, twenty.  
p or  
c Jam ten, three six zero, twenty.  
e We were looking for requests for display of the  
e countermeasures options, and you don't even want to see  
e that, you just want it jammed, right? That's fine. So,  
e the next thing in our scenario we have is requesting a  
e display of what you do have.  
p Okay, do you have a display? Just to show me? Okay, real  
p fighter pilot priorities here are I don't really care how  
p many beeps and squeaks come out of the airplane when the  
p airplane decides to jam the thing. And, hopefully, the  
p jamming pod should be smart enough.... I mean, it's already  
p told me that it's a J band threat, it should have targeted  
p that and be ready to spot jam.  
e You want it to just go automatic when you tell it to jam?  
p Do it. I'm saying that without knowing what options I have  
p available to me. Do you want me to...?  
e Yeah, go ahead and rate that there.  
p Now, what am I rating? Am I rating "jam ten," which...?  
e Sure.

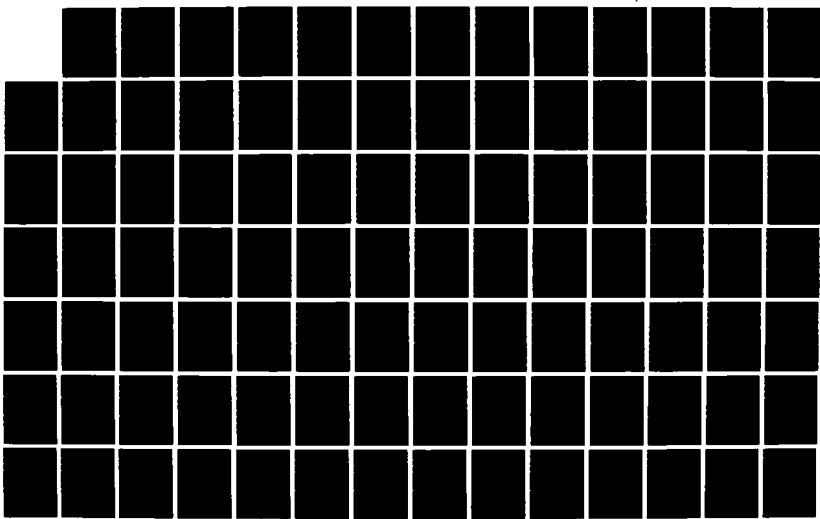
p Or "avoid east?"  
e 1.4.3 is "Jam ten." We'll skip 1.4.1 since you want auto-  
e jam. Just shows you what you have onboard.  
p In a situation like this, you'd have three possible  
p commands:  
c Jam, chaff, or flare.  
p And the only time I would probably issue a "chaff" command  
p is if I jammed.  
e So would you rate that there please?  
p So, what am I rating? "Jam," "chaff," or "flare" as three  
p different commands available?  
e Yeah, sure, sounds good. We've got some flexibility because  
e we're taping everything.  
p Speed, very good, conflict....  
e Okay, so we select ECM and chaff.  
v ECM and chaff selected; threat no factor.

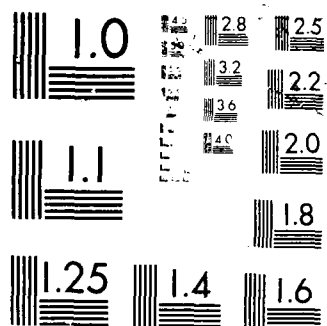
s 1.5.2  
e Rendezvous point approaching; threat is no longer a factor.  
p The threat's no longer a factor because the jamming  
p countered it?  
e Yes. Then the aircraft reports:  
v Rendezvous data.  
e What are your concerns and intentions now? You just  
e countered that threat; now the aircraft is telling you...  
c Display.  
e "Display," for 1.5.2. Could you rate that, then?  
p I'm firewalling you every time, because all this does make  
p it easier.  
e Here's what information you get.  
p My reaction to this is that I still know that there's an  
p SA-10 out there on my nose, for probably fifteen miles right  
p now; and regardless of whether the machine thinks it's a  
p threat or not, I still know the radar's out there. And he  
p may have shut down, realizing he was being jammed, but he  
p can come up. So that being the case, I would still want the  
p missile radar displayed, maybe with an X through it showing  
p that it has been successfully countered; but I still want it  
p out there.  
e This could be in the scenario also that we've moved up  
e several miles beyond the SA-10; but that's a good point,  
e that's important.

s 1.5.5  
e Rendezvous is complete. Your flight is escorting the  
e attackers toward the FEBA. As you approach within 25 miles,  
e your onboard system cues you:  
v Consent for fence check.  
e It can do the fence check for you. What are you thinking?  
e What would you like in that fence check? Or, what are you  
e thinking? What are you concerned about when you approach  
e this point?



AD-A192 972 A COCKPIT NATURAL LANGUAGE STUDY - SELECTED TRANSCRIPTS 3/4  
(U) MIDWEST SYSTEMS RESEARCH INC DAYTON OH  
R L SHALL ET AL. APR 88 AFHRL-TR-88-3889  
UNCLASSIFIED F33615-85-C-3623 F/O 1/3 NL





p "Consent for fence check" is a lot of syllables. I would  
p rather have it say "Fence check," and know that that's a  
p question or a reminder. Then I can respond by saying:  
c Cleared.  
p or  
c Roger.  
p Or, you know, "cleared" might be hard for a computer because  
p it's not distinct, syllable-wise, but "cleared" is standard  
p terminology. It asked a question. Fighter pilot lingo for  
p consent is "cleared." Is that alright?  
e That's perfect. What would you like to see in that fence  
e check if you could have it preprogrammed, before?  
p I would probably have IFF on approaching the FEBA. At least  
p I would still have mode four on, probably, and I would want,  
p probably, to shut down my IFF now. I don't know what JTIDS  
p avionics does for you if you're not squawking. You know,  
p AWACS is kind of useless to you right now if you're not  
p squawking, and that's a frustrating thing. So my real  
p priorities are stopping emissions. If I'm jamming and I  
p don't have to be jamming, turn the jamming off. If I've got  
p a TACAN turned on, shut it off, or put it in receive-only  
p mode, which is bearing and not range. Turning my radar to  
p standby, and going only on JTIDS data-link information, and  
p then forcing me to manually select the air-to-air radar on  
p if I want to take a real-time look at the situation. I  
p can't think of any other emissions that I would have. And  
p again, I don't know about JTIDS emissions. For instance, I  
p would have to be, probably, transmitting my GPS position to  
p JTIDS every once in a while for it to update the whole big  
p picture in the sky, and that's an emission. Now,  
p supposedly, that's going to be a secure emission. And then  
p chaff and flares might be another thing. For instance,  
p right now we have capabilities for doing a certain setup of  
p chaff and flares in a low-threat, non-threat situation, and  
p then increasing the number of chaff and flares I would  
p dispense when I got to a higher threat situation; and  
p normally that comes later, like at the pre-IP. When we get  
p to the pre-IP, we go from what we call multiples of chaff/  
p flares, to a program. And the reason we don't run a program  
p all the time is if we did it twice, we'd run out. So we  
p want to expend only a little bit of chaff and flares on the  
p way to the target and save as much as we can for the target  
p area, and then go back to only a little bit for egress if  
p we can get away with that.  
e Could I get you to rate that then, on 1.5.5?  
p So, chaff, flares.... And my response is:  
c Cleared.  
e That's fence check.  
p Fence check, yeah, fence check cleared.  
v Fence check complete.

s 1.6.1  
e We did it for you. You're now initiating a transition to  
e low-level: 500 knots, 200 feet. Your aircraft has full  
e terrain following capability. You need only select value  
e modes and check equipment status. Describe your situation,  
e concerns, and intentions at this point.  
p My situation is that I'm crossing into a high threat area.  
p My values, I assume, would be for how fast and how low I  
p want to be in the terrain following mode, right?  
e We're going to set the clearance plane, etc.  
p How fast and how low, right? I would probably want to issue  
p an airspeed command and an altitude command, and then call  
p up some kind of horizontal situation display again that  
p would give me threats.  
e Okay.  
p Now, again, we're only operating with one CRT. It's given  
p me this picture right here; and at the same time, on the  
p next CRT, it's giving my weapons display. You talk about  
p modes, and in terms of a weapons delivery mode, I don't  
p really know what I'd have called up. I would probably still  
p have a HARM called up in priority over an air-to-air missile  
p crossing a FEBA, because I would assume that SAMs would  
p probably be a bigger threat in the FEBA area than air-to-air  
p missiles.  
e What we'd like you to do is give us a command to call up  
e that terrain following display so that you can set modes.  
c TF.  
p Or something like that. If it can:  
o TF, five hundred, two hundred, go airspeed altitude.  
p And that's about it. Speed, my speed is poor, but this  
p would probably be helpful. This is like speed as opposed to  
p manually selecting some values?  
e How do you do it now? Or, I guess you don't....  
p We don't have the TF mode. We ought to kind of put it in  
p the middle for workload here. And the reason being is  
p because I'm probably sweating bullets right now and the  
p computer playing twenty questions with me while I'm crossing  
p the FEBA is.... I mean, it's a helpful sort of thing, but...  
p Well, I think I'd just as soon be flying the airplane as  
p letting the computer fly the airplane. And the terrain  
p following thing would be nice to have. Of course, if the  
p weather was rotten and the visibility was rotten, I'd much  
p rather have it flying the airplane than me. So that's kind  
p of a situational sort of deal.

s 1.6.3  
e Here's the display we just had. It showed you the clearance  
e plane, altitude, low warning, and so forth, and what we want  
e you to do is just to select either manual or auto by voice  
e command. How would you do that?  
p Manual is where it would give me steering and I would  
p manually fly it.

e Auto's where it takes over with autopilot.  
o Fly.  
p If you can think of a one syllable word...like on a tape  
p recorder, if you had "manual." That word doesn't have two  
p distinct syllables. So I would probably put "fly" or  
c Auto.  
p Okay, if it says "fly" and I say "fly," I'm going to have to  
p fly the airplane; and if it says "auto," George is going to  
p fly the airplane for me. But that's personal preference  
p only.  
e Oh, you'd just say one of the words?  
p Yeah, I'd say "fly" or I'd say "auto."  
v Auto.

s 2.1.2  
e Low level transition has been completed and you're  
e proceeding at two hundred feet above ground level. Current  
e threats are on the horizontal situation display. You get  
e this message:  
v Threat data.  
p That's an SA.... Or, that's a gun dish.  
e Yeah. And that said "Threat data," and he's positive,  
e that's an aircraft of some sort, air-to-air threat.  
p Anytime a new threat comes up, it says "Threat data" to me?  
e Yeah, that's to draw your attention to it. It's just like  
e before; it's telling you "I got more info if you want it;  
e I'll just bring it to your attention." Do you like that  
e idea?  
p Yeah, I like that idea, but I'll tell you what else I like:  
p Since I'm not flying with my head buried between my legs,  
p then what I want it to do is to say something like "Threat,  
p left eleven, twenty."  
e You want all that chatter? Some people don't.  
p Well, that's what we'd say to each other.  
e Would a symbol on the HUD be as useful there?  
p I don't think on the HUD, unless we have a holographic HUD  
p anywhere we turn our head. Is that part of the plan?  
e Could be. That's good, though, to hear that you want that  
e information.  
p One other way you could do this is to say "Threat." And  
p have whatever the computer was talking about flash until I  
p acknowledge, because some new gizmo came up on the screen,  
p and I'm looking over my shoulder. All of a sudden I come  
p back after it said "Threat" and all I see is this; so I'm  
p going, well, okay, 20 questions. What's new on this  
p picture, you know? And as a result, it may be something  
p that I'm not terribly concerned about. Or let's say it was  
p another gun dish right next to the gun dish I had before.  
p At that point I don't really care; but I'm not really sure  
p what's new.  
e You wouldn't call it out unless it's really a threat? But  
e what you're saving is: instead of wondering what's new,

e have it automatically flash until acknowledged. You don't  
e have to go query the system to find out what's new, or tell  
e him where he's at exactly.  
p Yeah, if it just said "Threat" and flashed until I did  
p something to acknowledge the flash, that would be good. And  
p then that would obviate the necessity for verbally saying  
p "left, eleven, twenty" or "three five zero, twenty."  
e If you had to give a command, though, to get the detailed  
e information, what would you give?  
c Display.  
p I can see myself saying "Display," and four different CRT's  
p change pictures simultaneously. So, I would assume that the  
p system was smart enough to know that if it said "Threat,"  
p that it knew the next "Display" that came up meant that I  
p was talking about the threat....  
e Yeah, it just prompted you so, it sort of listens. Just  
e like a back seater would. (Shared context.)  
v Helicopter eighteen miles, twelve o'clock low, closing.

s 2.1.4 and 2.1.6  
e And now this is a valid threat, it's a Blue Thunder,  
e Airwolf-type helicopter that you have to deal with. What  
e are your concerns and intentions at this point?  
p "Helicopter" is too long a word. I don't know if "copter"  
p or "chopper" or something shorter than helicopter would  
p help. "Twelve o'clock" is too long. Again, well, you have  
p "chopper" on the screen, that cuts out "helicopter," that  
p cuts out two syllables right there. So that would be good.  
p Again, I would say, "chopper three five zero, eighteen."  
p And what else does it say, "closing?" "Closing" again is a  
p superfluous comment. If I'm pointed in his direction and  
p he's pointed my direction, and I can see which way his nose  
p is pointed.... And even if his nose isn't pointed, he's  
p closing on me because I'm going five hundred knots and he's  
p probably only going a hundred and fifty or he's hovering in  
p the trees.  
e So if we didn't know his exact aspect but we had an idea  
e which vector he was taking and we didn't show you the vector  
e but instead showed you the display where we pointed his  
e nose, that's good enough for you?  
p Well, okay, I'm assuming that this little target symbol is  
p where his nose is pointing. Is that true?  
e True.  
p Okay, so I'm looking at a hundred and eighty or a hundred  
p and seventy degrees of left aspect right here. It says:  
p "Chopper, three five zero, eighteen;" I would want to issue  
p one of two commands:  
o Avoid.  
p or  
c Target.  
e Why one over the other? Why would you choose one, and,  
e then, why would you choose the other?

p It's the Army's job to shoot helicopters down. You know, I  
p mean, I'll shoot a helicopter down if he's a threat to me,  
p but I don't want to waste an eighty thousand dollar missile  
p on some fucking Russians flying around at a hundred feet  
p whose.... I shouldn't say that, I'm sorry.  
e That's alright, we think they're "fucking Russians," too!  
p You know, maybe, as they get more and more sophisticated  
p helicopters.... You know, more Hind D. And if they get an  
p Apache equivalent....  
e But that's the idea, here, this is something that you have  
e to deal with; he's got missiles that can kill you.  
p Then, they'll become more of a game out there. "Avoid" or  
p "target;" I shouldn't think I'd ignore him because he's a  
p threat to me. So, "avoid" should give me new steering; and  
p in that case I should say:  
o Avoid east.  
p or  
o Avoid west.  
p Or some direction.  
e "Avoid..." and it could give you what follows? A best  
e estimate depending on terrain and threats.  
p That's right.  
e Could you explain what you want for "Target." Do you want  
e that to automatically set up your weapons, get the radar  
e locked-on...?  
p Yeah, because what we've said is that I've been flying  
p around with HARM selected because I did a FEBA crossing.  
p And I haven't had any air-to-air threats come up. This is  
p the first air-to-air threat, so if I say "target," I should  
p automatically have a missile come up in priority. Now what  
p I might want to do is say:  
o Target short.  
p or  
c Target long.  
p If those are the choices you're going to give me.  
e The other thing is if you say "Target," and the conversation  
e has been discussing this chopper, pick the best missile for  
e that threat.  
p That's true.  
e You might still want to override because you know that  
e you're going to need your long-range missiles later.  
p Yeah.  
e If I can get you to rate that there....  
p What I'm rating is "target" or "avoid," and then "target  
p short," "target long," stuff like that? The speed is about  
p the same as what I manually do. And I've done about ten or  
p twelve F-15 sims, and all I had to do is flick my finger to  
p go between different types of missiles. So the speed....  
e How about the F-16?  
p Well, we only have one type of air-to-air missile on the  
p F-16. Now, if I want to switch from air-to-ground weapons  
p to air-to-air weapons, all I have to do is flick my thumb.

p So what you're telling me is that I have to say something,  
p when in reality, in the airplane, all I'd have to do is one  
p thumb flip and I would go from HARM priority to air-to-air  
p missile priority. One of the other things that comes up in  
p targeting is, is my radar turned on? If my radar isn't  
p turned on, the word "target" may also automatically turn my  
p radar on and lock onto this guy. Speed is about the same.  
p Conflict.... Workload I'm going to put as poor because I'm  
p having to say something when it's very easy to make a thumb  
p movement. And usefulness, probably poor also.  
e You said before that you wanted to target automatically: so  
e what you get is:  
v Master arm on.  
p That's bullshit! Because, what happened when I did my fence  
p check? My master arm was on, right?  
p What I want to hear right now is.... Well, first of all, you  
p talked about it selecting a missile priority based on the  
p type of threat out there. I've told it to target, and I'd  
p want it to say "Long ready" or "Short ready." That means  
p that the missile is in priority; it's ready to be launched.  
p Anytime I hear a "Long ready," it means that the radar is in  
p fact locked-on to the target. Now, that gets back to one  
p other point: If I've said "target" to the computer and I've  
p put my missile switch in the long position, then that should  
p automatically command the radar to lock-on. If I put it in  
p the short position, that would not necessarily command it to  
p lock-on if the computer was such that it could generate HUD  
p steering to the target without a lock-on. Now, "Ready" does  
p not mean that I can fire right now, necessarily; it just  
p means that the missile's in priority. It knows what I have  
p selected and, in the case of a radar missile, it locked-on  
p to the target. Does that make sense? (Lots of head nodding!)  
p And then the next thing that the computer should tell me is  
p "Shoot." All "Shoot" means is that I've reached the dynamic  
p launch zone of the missile.  
e We're getting good information here. We just called it long  
e or short ready. However you want to rate that, this is just  
e to know if the radar locked okay, which you want automati-  
e cally anyway.  
p Basically, I'm going to put same there, because right now  
p we have a ready mnemonic on our stores control panel, and I  
p can look down, and it says ready. It just says "RDY," and I  
p know it's ready. But the one thing voice would do for me,  
p in terms of the radar missile that would be helpful, is if  
p it says "Ready." That tells me that it's automatically  
p locked-on to that target; that would be handy.  
e Here's what it tells you:  
v Radar locked, in range, optimum five seconds.  
p By "radar locked," it's assuming I'm going to be shooting  
p the long range missile or radar missile. That's a whole lot  
p of verbiage to tell me something that.... Again, the shoot  
p cue that I told you about.... The F-15 actually has lights



p that go "shoot shoot," and they're up here on the canopy  
p bow. In the F-16, we have a symbol in the HUD, where I have  
p a circle which represents the field of view of the missile,  
p and whenever I get in the dynamic launch zone of the  
p missile, that flashes. So it never says shoot, or we don't  
p have shoot lights. But anytime that flashes, I know that  
p whatever I'm locked-on to is within the range of the....  
p It's whenever the target that I'm locked onto is within  
p the dynamic launch zone of the missile, so it could be  
p outside of the HUD field of view.  
e Circle starts flashing...  
p Yeah (pointing to a picture on the wall) that's an F-15 HUD,  
p a present from an F-15 guy. He was tracking one of our guys.  
p But, yeah, it's called a DLZ flasher, dynamic launch zone  
p flasher, and, basically, whenever your missile can hack the  
p way to the target, it'll flash, and the target does not  
p have to be in the HUD field of view for that to happen.  
p All you have to do is be locked-on.  
e Alright.  
p And "optimum five seconds..." All I'd want it to do is  
p maybe say "locked." I said before if it said "Ready long,"  
p then that means it's already locked-on, so that would be  
p superfluous.  
e Okay, that's good. Alright.

#### s 2.2.2

e The helicopter goes down in flames, and you proceed on  
e course through a mountain valley approaching a lake. The  
e formation is still intact, but you realize the helicopter  
e explosion will now highlight your presence. And the  
e aircraft gives you this:  
v Threat data.  
e And it's supposed to be this new threat. It's not telling  
e you that that's the new threat. We discussed that before.  
p Okay, and the only thing I'd say there is:  
c New threat data.  
p If it flashed or did something on the scope to let me know  
p what's new, then that would be great.  
e What command would you give to get the information on that?  
c Display.  
v ECM ineffective, reroute available.  
e It said "ECM ineffective, reroute available."  
p Okay, how about, "Jam ineffective," back to one-syllable  
p words. I think "ineffective" probably isn't very good  
p either.  
e That's a long word.  
p "No jam," or "Negative jam," you know, something short and  
p concise. I mean, that's going to make it a lot easier to  
p design something that'll speak in one-syllable words anyway.

s 2.2.4  
e How would you get the information on that if your  
e countermeasures were ineffective and you want a new route?  
p Okay, so it said "ECM ineffective," and "new route?" Is  
p that what it said?  
e "Reroute available."  
c Display.  
p Because it just told me something. It should know that, if  
p I say "display," I want it to display what it just prompted  
p for....  
e OK, please rate that at 2.2.4. Here's what it gives you:  
e it's showing that you need to accelerate to 510 knots to  
e meet time on target, if you take the new route.

s 2.2.6  
c Select.  
e "Select route?"  
p Just "select." What other words have you heard to go with  
p that?  
e Instead of "select?"  
p Yeah.  
e "Okay," "Go ahead and do it," "Take reroute"....  
p You want to have probably one or two choice words at the  
p bottom of the screen to give the pilot a choice of commands  
p to say. If it requires more than that, then it's probably  
p too complex.  
e Could you give us a command to pass that information to the  
e other members of your flight? Give a command to your plane  
e to pass the information to the other members of your flight  
e via data-link.  
p What I would want to do then is say:  
c Select, send.  
p or  
c Link.  
p I'm trying to think of words that are more clear, you know.  
p "Link" seems clearer than "send," but either one of those  
p would be good to pass that information.  
e Want to rate that one?  
p Speed would be very good, rather than having to verbalize  
p all that on the radio. Conflict, good. Workload, good.  
p This and this, good.  
e And here's what you get:  
v Message sent.  
e What do you think about that response? Do you want an  
e acknowledgement?  
p Yeah, I guess I do, "Message sent" is okay. You know that  
p seems long. I can't think of anything better. You know,  
p even a visual cue that it was sent would probably be just as  
p good.  
e Billboards?  
p Yeah, that'd be great. You got to watch beeps because we  
p got beeps for RHAW, and we got tones for missiles, and we've

p got caution warnings for things not working right.  
e How many words do you have?  
p Lots.  
e Is there any chance we could hear some of them?  
p Yeah, I'll take you in and show you some tapes. I wish we  
p could have given one of you guys a ride. Either an aural or  
p a visual cue. An aural cue would be good. You know, if I  
p say "link," and it does that "Message sent." And I can get  
p a response right away, then that would probably be good. We  
p also get tones for IFF, as well. So we get IFF, missiles,  
p RHAW, and the bitching betty. That's a lot of things to  
p listen to.

s 3.1.2  
e You're proceeding on the rerouted segment of the low-level  
e at two hundred feet. Aircraft reports from JTIDS update  
e that a new air threat now exists. Here's what you have:  
e The horizontal display has automatically changed scale and  
e the threat aircraft are identified with location, direction,  
e speed, and altitude. Your aircraft is still set up for  
e countering low altitude threats. What are you thinking now?  
e Yellow means that they have not been identified yet.  
p Low altitude threats meaning what, surface-to-air threats?  
e Yeah, you could say that.  
p Okay, so it's going to say "Threat," and I'm going to say:  
o Display.  
e Well, it didn't really say "Threat."  
p Well, you know what is probably good.... Generally, when we  
p say "threat," we're talking surface-to-air. When we say  
p "bandit," we're talking confirmed hostile, and when we say  
p "bogey," we're talking unidentified air-to-air; so, bandit  
p and bogey are air-to-air. And threat, generally, refers to  
p surface-to-air.  
e So really for that chopper we should have said, "Bandit."  
e Could we get you to request a configuration of your aircraft  
e for an air-to-air BVR at this point?  
c Sort.  
e That would do it?  
p That would do it.  
e What do you want "Sort" to do?  
p Okay, what I want "sort" to do is break out the formation.  
p What we do when we manually sort on a radar is that.... If  
p we were a four-ship of F-16's or a four-ship of F-15's going  
p up against something like that, someone will identify them  
p on the radar, assuming we could reach out that far and lock-  
p on to them. And we'd say "Bogeys, three four zero, two  
p hundred." Or because we may or may not have locked-on, we'd  
p say "Hits, three four zero, two hundred." When someone  
p locks-on to them, we say "Contacts, three four zero, two  
p hundred," which is bearing and range. And then the  
p altitude, fifteen, and aspect angle if we've got it. In  
p this case, one-twenty. Okay, our Eagle guys you'll hear say

p "one two." They just use two digits, because that's how  
p it's displayed on their VSD, which is their God's-eye  
p display. So at that point you start sorting, and for F-15's,  
p sort starts occurring farther away, because they have a  
p longer range radar, and our radar is shorter. And we don't  
p sort nearly that far out because we don't get contacts that  
p far out. But the idea behind sorting is that we're going to  
p try to pick out each one of these guys to see where he is in  
p relation to everybody else in the formation, and what their  
p altitudes are, for instance. Let's say that you had two of  
p these guys at five thousand feet and two of them at twenty  
p five thousand feet. That's real significant because you  
p could target two very easily and have the other two go high  
p outside of your radar coverage and if you didn't have JTIDS,  
p or JTIDS broke down all of a sudden, now you've got two  
p hostiles somewhere over the top of you and you don't know  
p where they are. That's the way we talk about going through  
p an intercept is detect, sort, target, intercept, engage, and  
p egress. And that's Air Force standard in terms of a  
p chronology of what happens. So the system's done the  
p detecting, I want it to sort. And now after I do that, what  
p I'll do is target, and that would have to get into specific  
p targeting terminology, because before, when I said "target"  
p and we were talking about the chopper, it knew what to  
p target. And now when I say "target," not only do I want to  
p tell the computer what's the target from my airplane to a  
p bandit but I also want to tell my wingman who he's  
p responsible for targeting as well.  
e We're going to get some of that as we get into the scenario.  
p If I'm talking too much, stop me.  
e No, you're alright. Your explanation gives us context. It  
e is very important to hear a thorough explanation.  
v Configured air-to-air.  
p Unnecessary. Again, we got our thumb switch, whatever you  
p want to call it, but I'll just put pcor all the way down.  
p It's much easier to do with a flick of your thumb than have  
p something talk to you.  
e That's good to know.

#### s 3.1.4

e What we're looking for next is setting up our missiles.  
p Well, this is kind of good...understands command...indicates  
p command understood and carried out. I flick my finger to  
p air-to-air missiles, and it automatically turns terrain  
p following radar off and air-to-air radar on. The radar  
p altimeter should have nothing to do with the ground map/air-  
p to-air radar, because they're two different transmitters in  
p the airplane. Or, at least, the way airplanes work now  
p they're two different transmitters. So the radar altimeter  
p would not necessarily need to be turned off. And we don't  
p have radar altimeters; the F-16C does. And that's just  
p going to be on as long as you leave it on, and will continue

n to put radar altitude data in the HUD. And I would assume  
p this would probably do the same thing. Remodes the radar,  
p that is good. And, again, what we can do in the F-16 now  
p is.... Let's say I'm in a ground mapping radar mode; to do a  
p radar delivery or at least a ground map to identify differ-  
p ent turn points on a low-level, flicking my thumb one posi-  
p tion or to another position automatically turns it either to  
p a normal air sweep mode where I can sweep the area and try  
p to detect targets; or, if I'm really worried about something  
p close, I can go into a what's called an auto-acquisition  
p mode where I put it in one position, and the radar goes  
p through a preprogrammed sweep, and will automatically lock-  
p on to whatever it first detects. There are four different  
p sweeps. The F-15 has identical ones to us. One is called  
p vertical scan, where it just sweeps up and down our nose.  
p The one we most often use in a situation like this is called  
p slewable ACM. And the F-15's called auto-guns. Basically,  
p all it does is... I give it a chunk of airspace and say I  
p want to search from my nose out to ten miles. I want my  
p sweep to be plus or minus sixty degrees, four bars high, and  
p search that airspace and lock onto the first thing it sees.  
p It takes a big cone of airspace, but what you can do is you  
p can put that chunk wherever you want it relative to your  
p nose. So if you think the threat's coming in over here and  
p it's inside ten miles, you just put the HUD symbol over  
p there, and it automatically will lock on.  
e Is this slewable ACM?  
p Yes, slewable ACM stands for air combat maneuvering. Slew-  
p able means that you can slew it wherever you want. And the  
p other modes are vertical scan, or we call it ten by forty.  
p Another mode is called boresight, where it locks-on to what-  
p ever is on a boresight cross right in your HUD. And the  
p last mode is called twenty by twenty. Or the F-15ers call  
p it super search. And all that is, is a twenty degree by  
p twenty degree search of the HUD field of view. So it's just  
p something in your HUD field of view. All of them go from  
p your nose out to ten miles, and it will reject any target  
p outside ten miles. Now what am I rating?  
e Request set up of your missile, long AIM.  
p Yeah, I guess "long AIM" is what we said before, right? Or,  
p is it? Well, that's what you would say to me is "Long  
p ready," "Short ready." What did I say right before "long  
p ready" or "short ready?"  
e Well, you had to avoid a target, and when you said "Target,"  
e we assume that it was already preprogrammed. And you get  
e the response back "Long" or "Short ready" based on what it  
e had said.  
p All I would want to do is go to an air-to-air mode or an  
p air-to-ground mode, and it could say "Short ready" or "Long  
p ready." But, again, if I had a mnemonic somewhere in my....  
p You know the display you have where you show all your  
p missiles on the silhouette of the airplane? If there was a

p "ready" displayed down there, that would be good also.  
p Maybe it would be nice to hear that on headset, but, again,  
p we're talking about all this in isolation, and there's so  
p much stuff going on, that the less talking that I have to do  
p and the less I have to talk to the system, probably the  
p better. As long as I can keep my workload down. So "Long  
p ready," "Short ready" in this situation would be nice  
p because what I've done is I've changed weapons delivery  
p modes. And as soon as I change weapons delivery modes, I  
p told it to "sort." I guess we're talking two different  
p things. Long ready, short ready would be on a different MFD  
p or CRT. And they would just give me a ready mnemonic for  
p the missile I had in priority. And then "sort" would expand  
p this display of the four targets here to give me more about  
p aspect angles and altitudes on them. I'll just put poor  
p here for "long ready, short ready." And that would refer to  
p whether I think I really need a verbal cue there.  
e Here's what we get from that last one:  
v Master arm on.  
p Unnecessary.

s 3.1.6

e This aircraft is equipped with an infrared search and track  
e system. Now, the next thing we want you to do is bring up  
e that display. What we're getting at now is...

p And you just want a command for that?

e Yeah.

c IR.

e And you get.... Here are your four targets out here; here's  
e their azimuth; here's your nose, up here. The IRST detects  
e four IR heat sources at twenty-two degrees left, twenty  
e degrees high. JTIDS information estimates the range at a  
e hundred eighty-five nautical miles.

p So I haven't turned my air-to-air radar on then?

e No.

p Now we need to get back into something I said before. I  
p said anytime I went to a long-range missile, I turn my air-  
p to-air radar on. It might be a good thing in this case,  
p then, to say what I would preliminarily do is go to short-  
p range missile first to see if I had adequate JTIDS  
p information for steering. And I could get an IRST track.  
p And if I could get those things, then I'd run the intercept  
p with JTIDS and IRST. And if I couldn't get that informa-  
p tion, then I'd push into long-range missiles with my thumb  
p to turn the air-to-air radar on. Does that sound  
p reasonable?

s 3.2.1

e Could you give us a command there for getting detailed  
e information on this, on what's out there?

o Sort.

v Hostile.

p Well, was I supposed to ask it to ID or...?  
e I'm sorry, my mistake. If you were trying to ID them, what  
e would you have said?  
c ID.  
e That's what I need. You didn't let me sway you? That's  
e what you want to say?  
p No, I think that's real good; it's short, to the point.  
e You probably want automatic ID, as soon as it knows....  
p Well, for instance, it was displaying them as yellow before.  
p And I would assume the system would be smart enough to go  
p through IFF interrogation and then whatever other gizmos we  
p had to figure that out, and automatically turn them red  
p whenever it could.  
e Would you want it to be doing interrogations? You might be  
e using an emitter.  
p Yeah, that's a good point. It's hard to figure all this  
p stuff out without ever having flown with it. I guess what  
p I'd want is for AWACS or whoever was flying around.... If  
p they could ID those guys and transmit it via JTIDS, I'd want  
p it to turn red as soon as possible. What I would probably  
p want is some kind of cue telling me that JTIDS was unable to  
p confirm whether those guys were bogeys or bandits, to force  
p me into requesting the ID.  
e That's what the yellow was, I guess....  
p All the yellow does is tell me that they're bogeys; it  
p doesn't tell me that JTIDS has tried....  
e Oh, tried to ID them?  
p Well, by definition JTIDS would have tried to ID them. "ID"  
p is a good command.

s 3.2.3

e Alright, now we have the option of getting a closer look.  
c Sort.  
p I think, would come in. All "sort" is going to do is give  
p me more information about the type of formation they're in  
p and the altitude splits within the formation.  
e If you could rate that one?  
p Let me go back. "ID," that's very good. "Sort," very good.  
e Here's what you get...breaks it out, close up.  
p Okay, you call that "zoom." We have a ground map mode we  
p call "expand," but "zoom" is better. It's a one-syllable  
p word. Now, this is a nice display; but, you know, I had  
p four little dots, and now all I have is four big dots. And  
p what is it telling me? Not a whole lot. So what I need now  
p is more info on altitude, probably next to each one of these  
p guys. Rather than four dots, what I need is vector infor-  
p mation. Again, like we talked about. So I want to see,  
p probably, triangles, with a little pitot tube sticking out  
p in front of the triangle, showing their current vector.  
p Like, this is C Model F-16. But it's a pretty good display.  
p The length of the pitot tube would equate to what their air-  
p speed is, and then a little number next to each one of them

p indicating their current altitude.

s 3.2.5

e This has the ability to give you a future track analysis of  
e where these aircraft are going to be. How would you request  
e that? You know how you were telling us where they've been,  
e and, based on their current speed and direction, where they  
e are going.

p I don't think that's necessary. If I have their vector  
p shown by their little pitot tube on the front, I can tell  
p which way they're pointed. All I'd probably want is what's  
p called a CATA symbol. That's what I was talking to you  
p about before. It's CATA, C-A-T-A. Stands for collision  
p antenna train angle. Antenna train angle is the number of  
p degrees off your nose that your radar antenna is pointed or,  
p in this case, your IRST sensor is pointed. And collision  
p antenna train angle is the number of degrees that you have  
p to displace your antenna from your nose in order to be on a  
p collision steering course with the target. If you have less  
p degrees than the CATA, then you will run a cold intercept  
p and pass behind the target. And if you have more degrees  
p than the CATA, you will run a hot intercept and pass in  
p front of the target. So all I would want, probably, here is  
p more detail, target depiction, target altitude, and a CATA  
p symbol. And I don't think a future track display is of very  
p much worth because what happens is, they're still, say, a  
p hundred and fifty miles out here. Until they're closer I'm  
p not going to be thinking about shooting at them. And I  
p don't really care what the computer thinks they're going to  
p do a hundred and fifty miles away when the situation has a  
p long time to change in the intervening time. Now, 3.2.5 is  
p instructions for what?

e Requesting track analysis. Here's what we give....

v In range for air-to-air radar.

s 3.2.7

e The next thing to do is request air-to-air radar. We  
e already talked about setting that up before.

p Well, I guess my conception again is that I've got my little  
p thumb switch in short-range missiles now, and that's forcing  
p me to display only JTIDS and IRST information.

e Before we didn't have the radar on. We had everything off;  
e so it's telling you now that they are in range for air-to-  
e air radar to you.

p I'd want it to say "In range long." And that would be a cue  
p to me that if I want to try a max range shot against these  
p guys, then I've got to switch modes. And by switching  
p modes, it would automatically turn the radar on and auto  
p lock-on to the targets that I've designated with IRST. And  
p then I would manually select long-range missiles.

e Well, what if they were in range for the radar and not the  
e missile, necessarily? In other words, if it was a focused



e beam of radar energy, that might go quite a ways.  
p The last thing the computer said "In range radar" or....  
v In range for air-to-air radar.  
p And you're just talking about radar and not the weapons at  
p that point?  
e Right.  
p Again, I don't think it's necessary to tell me it's in range  
p for the radar. As long as I have target distance data, and  
p if I wanted to select air-to-air radar, then I would go  
p long-range missiles. And at that point it would know I want  
p a radar missile; and it would turn the radar on and lock-on  
p to that target. I'd flick my thumb and be there.  
e So you wouldn't have a command for that?  
p No.  
e Okay.

s 3.2.9

e This is when your radar comes up. This is what you have:  
e Four-ship estimated type, MIG-39. Your onboard air battle  
e management system has computed optimum intercept profiles.  
e These intercept options are available upon request.  
p Range. Azimuth. Antenna tilt. What is this?  
e Hundred-mile scale.  
p Oh, hundred-mile scale. And what is this?  
e Fifteen....  
p V sub c? Do you know it? Do you know what v sub c is?  
p It's closure velocity, okay. This is almost identical to  
p the F-15 vertical situation display.  
e I'm not sure what the fifteen hundred was about.  
p Yeah, I think that's v sub c up there. The one thing that  
p you don't have up here that I would like to have is target  
p altitude. Now, what this looks like is an F-15 pre-lock-on  
p display, where you're painting targets, but you haven't  
p locked on yet. It says track while scan. Again, altitude  
p would be nice. I'm assuming here that this is a pre-locked  
p display. So once he locks on that, I need to get target  
p altitude in there some place.  
e Okay.  
p Alright, now, the question is....  
e We're looking for you to select an intercept option.  
e They're available, how would you ask for one?  
p What you want from me is different words for different types  
p of intercepts?  
e Well, the computer has calculated the best intercept options  
e for you.  
p For different types of intercept, though?  
e It'll show you a couple of intercepts it thinks...  
p Alright, what I would want then is the different intercept  
p option names down here below.  
e So you can see what they are?  
p Right. Remember, we were talking about having verbal cues  
p down here at the bottom of the screen for idiots who can't

p remember what the cues are. So one should say "stern."  
p That's going to show me how to get around and do what's  
p called a stern conversion. And one should say "CATA," and  
p that, again, would be basically, a pure pursuit intercept to  
p meet them at some point out here, assuming they're going  
p across the scope. I'm going this way, and I'd meet them  
p somewhere inbetween. Pure pursuit CATA. You might also  
p want to have one other one called "beam," where a CATA  
p intercept could bring you in with a heading crossing angle  
p of, say, a 120 or 150 degrees. What you want to do is get  
p to a situation where you have less than 120 degrees of  
p aspect angle. And if you have less than 120 degrees of  
p aspect angle, and if they have radar that sweeps plus or  
p minus 60 degrees of their nose, then you have gotten outside  
p their radar beam search pattern. So a beam intercept would  
p initially drive you at them, and then take you cold a little  
p bit, but not like a stern conversion. But basically bring  
p you in from the side so you'd be shooting on the beam and  
p taking them out like that. So, probably three options:  
o Stern.  
o Beam.  
o CATA.  
e Just use those words to select whichever one you want?  
p That's right.  
e What if you're a new guy, though, and, since you're a second  
e lieutenant, you didn't know which one might be best? You  
e say, "Okay, computer, show me some options." How would you  
e ask for that?  
p Lieutenants don't make those decisions. And, secondly, what  
p are the criteria it's going to use for determining best?  
e Some of the things you said, PK, stuff like that.  
p Well, you know, I'll use my computer right now (points to  
p head). Anytime you can run a stern conversion on somebody  
p and shoot them from dead six and he never sees you coming,  
p that is absolutely the best way to do it. The problems with  
p stern conversion intercepts are: (1) you do a lot of turning  
p in the intercept, so you make yourself vulnerable to being  
p picked up by somebody while you're in the turn; (2) you've  
p got to swing his wingline, which means if he's looking out  
p the side, he may see you swinging his wingline out there;  
p and (3) if, for instance, he pushes it up at all or you go a  
p little bit colder than you should have, you end up in a tail  
p chase; you're out of range, and now you're in a bad  
p situation. You got bad guys in front of you, you got bad  
p guys behind you, and not a whole lot of situational  
p awareness. So, I don't know how you would have a computer  
p make those kinds of tactical decisions. You know, I think  
p that should be up to the flight lead. And he should be able  
p to determine whether stern or a beam intercept.... You know,  
p in most situations, I would want a beam type intercept where  
p it would pick up a situation like this: it would initially  
p take me cold, and then once it got me down to less than 120

p degrees of aspect, it would turn and hold me right at about  
p 115 or 110 degrees of aspect right outside their radar  
p coverage as I came in and tried to shoot from about 100 to  
p 90 degrees of aspect. And, you know, AMRAAM shots....  
p You're talking about still taking fairly long shots on the  
p beam. What you want is a couple of fireballs at the merge.  
p If you can make a couple of them blow up, then the rest of  
p them are going to get kind of shook up. And then you can  
p either blow through and let them go away, or you can stay  
p there and clean up if you need to do that. So, to me,  
p that's a flight lead decision. I don't know how you program  
p a computer to make those types of decisions. But just giving  
p me some options, letting me make the decisions would  
p probably be good.

s 3.2.11

e Here's what we have: Option number one, due to its priority  
e number, has a shorter time to engage but a lower PK of about  
e 0.5. Number two is more conservative but offers a much  
e higher PK of about 0.98.

p Okay, I don't know who wrote this, but it wasn't somebody  
p used to fighting against radar missiles. And that's okay,  
p because this is a good learning situation. Rule number one,  
p if a guy's got a radar missile that's any kind of threat,  
p you don't ever cross his nose. Ever. So, all we're talking  
p about is looking at a situation like this and say which way  
p can I turn left and reverse back right to end up coming in  
p straight at them with, say, 120 to 150 degrees of heading  
p crossing angle, or coming in on the beam and coming in from  
p the stern. But if I cross his nose, whether he's got Soviet  
p JTIDS or a good air-to-air radar, I'm going to be a sitting  
p duck. Even if I'm out of range, he's going to be able to  
p have me on the beam and basically be able to target me even  
p though I know where he is. You know, why would I want to do  
p that?

e The guy who wrote it said he'd get a lot of flack for that.

p Okay, well, he's right.

e But he did it anyway.

p So I'd go back to my three options: Stern, beam, CATA. And  
p let the flight lead make the decision about....

e That's how you'd select...

p I'd select it.

e What did CATA stand for again?

p Collision Antenna Train Angle.

e So by looking at those options, you would know what they  
e meant. If they were displayed the way you like.

p First of all, I don't think you need a God's-eye view  
p display to show you what a CATA intercept or a beam  
p intercept looks like, because you have to have visualized  
p those in your head in order to know where you were going to  
p end up. What I do want, though, is an intercept steering  
p cue to tell me where to put my nose. And when I show you

p our radar tape, I'll show you what that means. But,  
p basically, what you would have is a cue generated on your  
p radar scope, or whatever you want to call it, MFD, or  
p whatever. And for CATA intercept, for instance, maybe it  
p would put a symbol about five degrees to the left of your  
p nose, telling you just turn a little bit this way and you'll  
p come in and you'll run a CATA intercept. For beam intercept,  
p it would probably put a symbol somewhere over near this one  
p and force you initially to turn about thirty-five or forty  
p degrees cold. And then as you got below a 120 degrees of  
p aspect and got closer to the target, it would now move the  
p collision steering symbol back to the center of the scope so  
p that you would be forced into a right hand turn. Can you  
p visualize that?  
e Yeah. You can use the scope for steering, too.  
p HUD steering would also work. The F-15 and the F-16 have  
p collision steering in the VSD. Because if I run in like  
p this, I may know he's there, but he also sees me here; so we  
p try to swing somebody's wingline and then come in from the  
p beam or with a large altitude split so they can't see me.  
p And I'm shooting ordnance at them before they are really  
p aware of what's going on.

s 3.2.13

e Again, give us the command to transmit that to your wingman  
e via data-link.

p I would say something like:

c Beam, send.

p And it would go beep, or whatever you guys figure out,  
p acknowledging that it has sent the message. So we've  
p detected, we've started sorting, but we haven't targeted  
p yet. I haven't told my wingman who to shoot down yet  
p because we're still too far away to do that. So all I want  
p to do is say we've detected, we've sorted, we know which way  
p they're headed. I say "beam, send." That sends it to my  
p wingman, it beeps, and now I start following the intercept  
p steering. And then we'll get into the targeting. I'm  
p rating it on "beam; send."

v Message sent.

p Alright.

s 3.2.15

e You're committed now against the air-to-air threat, but  
e you're concerned about the attack flight and request update  
e on their progress. How would you get the information?

p So I'm not with them now? I'm just kind of hanging out.

p Because, normally in a situation like this where we do  
p escort, we'd probably sit back and just follow them in.

e They're following you in at this point.

p They're following us in? That's fine.

e They're on the way to bomb the airfield now. You're going  
e up to intercept these guys. But, you want to know where the

e attackers are.  
p I still assume they're right behind me.  
e Let's say that they're...you're not sure where they're at.  
e You want to know where they're at. You're separating and  
e going to intercept. You got your missiles, you're at a  
e hundred miles.  
p I guess I don't really understand why they're not on this  
p scope to begin with. So my first reaction would be if I'm  
p supposed to be escorting them and it was smart enough to put  
p them on there before, why aren't they on there now? But we  
p could get to a situation where we don't want constant data-  
p link between the airplanes because you're still emitting  
p stuff when you do that. So there are good reasons probably  
p not to do those kinds of transmissions. Again, something  
p short and concise.... Boy, I don't know...  
c Posit.  
p Navy terminology for position is "posit;" Air Force guys  
p don't understand that. That's two syllables but it's pretty  
p clear. I mean, it would come across as understandable.  
c Posit.  
p with some word to indicate the bombers. I could say:  
c Posit bombers .  
p or  
o Posit escort.  
p No, we're the escort....  
c Posit package.  
p Or just plain:  
c Package.  
p Yeah, alliteration. I don't know, I don't have any good  
p ideas for this.... What have you heard from other guys?  
e "Where are the friendlies?" "Where's Saber 41?" and  
e "Where's the package?" "Where's the mudders?"  
c Posit mudders .  
p or  
c Mudders.  
p The real question, you know, is the computer going to be  
p intelligent enough to know who I'm talking about? Hopefully  
p it would be; but that's your job, not my job. So, mudders,  
p bombers, whatever.... That would all be great if you could  
p get it; that would be super.  
v IP inbound.  
e Telling you where they're at.  
p Oh. So, it's not going to display here?  
e You'd like us to display them?  
p Well, the thing is, if I've gone separate vectors from the  
p guys I'm supposed to be escorting, I've stripped from them,  
p because I think these other guys are a threat. And I  
p probably want some kind of indication of where they are  
p relative to me and relative to the threat. You know, if for  
p some reason these bandits turn away, then I would go back  
p and find my attackers. But I think what I would like to  
p have is some kind of INS waypoint symbology. Like right now

p on our VSD, we get our current INS waypoint displayed.  
p You know, on a more sophisticated system, where you had  
p ranges out to a hundred and twenty five miles, you might  
p have two or three INS waypoint displayed. And rather than  
p verbally telling me something, it would just show me green  
p little triangles out there and their position relative to an  
p INS waypoint. And what would really be nice is if the thing  
p were smart enough to know that INS waypoint should be  
p circled, and their IP on their target relative to the  
p threats where I am and whether I need to continue the  
p intercept or not.

s 3.3.1

e Alright, you are sure now that your responsibility is to  
e attack the air threat and allow the attack flight to  
e initiate their battle area tactics at the airfield. What  
e we're looking for now is you to ask for some intercept  
e vectors from your aircraft.  
p Give instructions to my aircraft to continue the intercept?  
e Well, you're asking for what is the best intercept angle.  
p I thought I already did that.  
e We're ready to give it to you now, basically. You were  
e asking for the options; now we're giving you actual vectors.  
p Alright, then what I would do before is I would say....  
p Any depiction of the options on this is unnecessary, because  
p I know what they look like. All I want to do is be able to  
p say a command like "beam," "CATA," or "stern," and have that  
p command generate steering on the HUD or on the VSD or HSD or  
p whatever. When I issue the command, it generates steering.  
e Why don't you cross through that one then, if you don't  
e have a command there?  
v Vector zero six zero.  
p Am I doing alright?  
e Yeah.  
p "Stern, CATA," alright... And, again, I don't need words to  
p tell me that. If it gives me a symbol that I can turn to,  
p all I want to do is glance down, see that there's a little  
p symbol thirty degrees right on my nose, and I'll turn thirty  
p degrees right.  
e Why don't you just cross through that whole rating box.

s 3.3.3

e You're halfway through your stern conversion. Enemy  
e formation's not maneuvering. Looks as though you have not  
e been detected. You're ready to split your flight and assign  
e targets. How would you tell your wingman to deploy, if  
e that's something you'd even do at this point?  
p Alright, well, you wouldn't split your flight unless you  
p absolutely had to do it. In this case, if you believe  
p you're undetected, you wouldn't split your flight. And, I'm  
p going to talk more F-15 mentality here, because their job is  
p shooting radar missiles from long range. And they always

p try, even if they're a four-ship, they try to stay together.  
p I mean, there are times when they fly an eight-ship "Wall of  
p Eagles." And they come in eight ships abeam, maybe over five  
p or six miles. And they just try to march on in, and when  
p they get to shoot range, they'll just try to have as many  
p missiles in the air against as many different targets as  
p they can. So, what I would want to do in this case, again,  
p is come in undetected. And I've detected, I've sorted, and  
p now I want to target. And targeting means assigning my  
p wingman and me different airplanes to shoot at.  
e If you had to tell your wingman to deploy, what would you be  
e telling your aircraft so that it would data-link it to....  
e Maybe a situation doesn't exist like that.  
p Well, okay. I guess the way we normally fly around is, my  
p wingman will probably be in line abreast, tactical formation  
p or maybe in a wedge formation. He's supposed to be out  
p there in a tactical formation. I shouldn't have to be  
p telling him to deploy; he should already be in a position  
p from which he can support me, I can support him, and we can  
p both employ ordnance. Because, you know, real world....  
p It would be nice to have 120-mile intercepts, but a lot of  
p times you get something that comes up over a ridge. All of  
p a sudden, an airplane comes over ridge, and you want to be  
p able to shoot it right away; and you can't go through all  
p this fancy stuff about, okay, deploy....  
e No command?  
p You could go to probably some TAC units, and they would  
p love to have a deploy call. The Guard and Reserves, or  
p situations where pilots fly together all the time, they know  
p what to expect of each other within a unit. In a normal TAC  
p squadron, about thirty percent of the squadron turns over  
p every year. In some overseas squadrons...I was in a  
p squadron in Korea, where ten percent of the squadron turned  
p over every month. And you have situations where pilots  
p don't fly together very often. And if you talk to people  
p who are in that situation, they might like a deploy call.  
p Now, my question to them is "Where was your wingman if he  
p wasn't deployed in tactical supporting position already?"  
p And you're probably doing something wrong. But I'm just  
p trying to show you a different side of the coin there.  
e Okay, good.

s 4.1.2

e Now we're ready to close on the target formation for  
e prioritization and target assignments.  
v Target assignment ready.  
e Your aircraft reports that. What we're looking for now is  
e you to ask it, "What are the assignments?"  
p Okay, I would like to have it say to me "Ready to target,"  
p rather than "Target assignment ready." "Ready to target,"  
p or just "Target," you know. I should know if it says  
p "Target" to me that it's commanding me or asking me to tell

p it who to lock-on to and all that stuff.  
e In our scenario, we're assuming the computer has initially  
e assigned aircraft to you and your wingman, and it's going to  
e show you what they are. I'm trying to get out a command  
e that will let you see them.  
p So it says to me "Ready to target."  
e It said "Target assignment ready." It has something  
e targeted. Or, in your words, "Ready to target." It's  
e trying to show you what it thinks a good target is.  
p Okay, and I'll say:  
c Target.  
e Please rate that.

s 4.1.4  
e And here's what it shows you: You are blue; that's you.  
e You got one and one, the blue; and your wingman will take  
e two. What do you think of that type of designation?  
p Yeah, that's good.  
c Accept, send.  
e "Accept, send?"  
p Because I want to tell yoyo over there (my wingy) who he's  
p supposed to shoot down, right?  
e Rate that one for us, please.  
v Message sent.  
p Okay, and that's a beep or something. What else have you  
p heard there in terms of accepting?  
e Others have asked for discrete symbols on the targets so  
e that they can make the assignments. In other words 1, 1, 2,  
e 2 doesn't help them. They say we should make it 1, 2, 3, 4.  
e Then you could say "No, I want 1 and 2," "I want 1 and 4..."  
p Let me make sure I understand this: 1, 1 means that I'm  
p going to shoot these guys; and 2, 2 means my wingman's going  
p to shoot these guys. I want a means of overriding that.  
e Oh, you have.  
p Okay. What the software should be programmed with is  
p standard targeting criteria. Each squadron has standard  
p targeting criteria. And pretty much throughout the Air  
p Force there are standard criteria: The leader always takes  
p the trailer; the wingman always takes the leader. If you're  
p in a side-side situation, then you sort side-side. And this  
p situation, this is kind of bullshit. Let's assume that I'm  
p here and my wingman's on my left. And this would be a  
p standard, say, 110 degree heading crossing angle intercept.  
p This would be a side-side sort, with me, the leader,  
p taking the two guys on the right and my wingman, who's on my  
p left, taking the two guys on the left. And that's pretty  
p standard. So we target leaders-trailers; and then we target  
p side-side; and then we target low-high, where leader takes  
p the low man and the wingman takes the high man. And that's  
p kind of the logic that we go through. So if the computer's  
p smart enough to figure that out, then that's fine. Then I  
p can override it if I need to.



s 5.1.2 and 5.1.4  
e We go on. It says, as your wingman moves out to line  
e abreast, the enemy begins to maneuver and appears to merge.  
e As you close within 35 nautical miles, the onboard systems  
e report the target split.  
v Targets crossed.  
e Target one appears to be converging on your flight. Target  
e two is attempting to separate towards the airfield and go to  
e the attack flight. What are you thinking now?  
p Well, what I'm going to do is:  
c Swap.  
p And that's the word we use. So I'd just say:  
c Swap.  
c Swap, send.  
e Okay, that's 5.1.4 also. Why don't you just rate 5.1.4,  
e and skip 5.1.2 because you got them both.  
p Play that back for me and tell me what it said again.  
v Targets crossed.  
p Okay, what we say on the radio if we see this is "cross  
p lock." It's kind of a tricky deal where the bad guys lock  
p across each other, and then they do this.  
e And you lose lock?  
p Yes.  
v Message sent.

s 5.2.2  
v Target in range in ten miles.  
e We're preparing to fire at two targets.  
p Alright, again, what I've said before is rather than a  
p verbal in-range cue, I would like probably a HUD flasher,  
p something in my HUD that's flashing. The F-15 may generate  
p an aural cue along with their shoot lights that says "shoot  
p shoot." Go over to the F-15 SPO and ask those guys. That  
p would probably be a neat thing to have in the airplane.  
p "Shoot shoot," and that doesn't mean push the pickle button.  
p It means look at your dynamic launch zone data and really  
p determine: do you want a max range shot; do you want a  
p heart-of-the-envelope shot? And now you've got visual cues  
p in the HUD that tell you where you are relative to the  
p dynamic launch zone of the missile.  
e So do you want to skip over to 5.2.2, or do you have a  
e command after you request preparation for firing on two  
e targets?  
p The aircraft reports target two will be in range in ten  
p miles.... Not necessary. Because, again, I've got visual  
p cues that I can look at, and I can see that I'm outside my  
p DLZ.  
v Master arm on, radar locked, in range, optimum five seconds.  
p Okay, "Master arm on" not necessary. "Radar lock..." At  
p some point during this intercept, I'm going to have to  
p request long-range missiles, because I've been in short-  
p range missiles....

e That's what I was wanting back there, I guess, request  
e preparation for firing at two targets. If you could give us  
e a command there....  
p What I would want is when I reach maximum range for.... Or  
p maybe it's something like 1.1 times maximum range.  
p Something, you know, about five seconds prior, at most.  
p Then all I'd want it to do is say "Long Rmax," and that's a  
p dummy cue to say "If you're in short-range missiles, push it  
p to long range." And part of that would depend on how  
p sophisticated the radar is, and how long settling time it's  
p going to take to turn itself on, open its eyes, point the  
p radar antenna in the right place, and go through a search  
p pattern around wherever theIRST thing is, and lock on. But  
p ten miles is too long. Ten miles is about 20 seconds,  
p probably. Twenty to 25 seconds, and I would say something  
p more on the order of 5 seconds. Just "Rmax long," and  
p that's a cue to me to go long. That turns the radar on and  
p automatically locks it on to whatever I'm tracking, and then  
p I can look up for an Rmax cue. And then at Rmax, I hear  
p "Shoot shoot."  
e Alright, we'll go on here and....  
p So I'll put "Rmax long" at 5.2.2, and I'll put very good  
p there.

s 5.2.4  
e Alright, we'll assume that you and your wingman fire two  
e missiles each and immediately disengage to cover your egress  
e with chaff and flares. How would you request this?  
p Request chaff and flares?  
e Is that your command?  
p No, I'll tell you what I would really like in the F-16 is,  
p any time I hit the pickle button, for an aural cue to come  
p up and say "Chaff flares." And that doesn't mean it's  
p sending it out; that means, "Hey, dummy, hit the button,"  
p okay? Now if you could program the computer to say "Chaff  
p flares" and, then, I give a consent to that....  
e Okay, so like we did on the "Consent for fence check?" That  
e type of prompt?  
p Yeah.  
e Or "Threat" and you say "What is it?"  
p Yeah. So what's a good one word thing for dropping some-  
p thing off the airplane, you know?  
c Chaff flares.  
e Go, dispense?  
p Yeah, "dispense" is kind of drop.... Just some one word  
p command. So, anytime you hit the pickle button, it says  
p "Chaff flares" to you.... Sort of a question, and then:  
c Send.  
c Drop.  
p What we do now is we hit.... And the F-15 guys, they've got  
p a pinky switch over here.... You guys can figure out a good  
p word for that, but....

v     Dispensed chaff and flares.

s     5.3.1

e     Attack planes have knocked out the airfield and are  
e     returning to base; the targets have been destroyed, and you  
e     are safely out of the battle area. You request rejoin  
e     information with your wingman. Assume that during the  
e     battle you got away from him.

o     Vector bombers.

o     Vector mudders.

o     Vector escort.

e     Okay, well, right now you're getting linked back up with  
e     your wingman. You got separated from.... The mudders are  
e     on their way home. They destroyed the airfield, and are  
e     headed back. You're wanting to get hooked up with....

c     Snap.

p     Do you understand "snap?" That's GCI terminology. And  
p     "snap" is short for "snap vector," and that means I want to  
p     turn real quick and point my nose in the direction of  
p     something. So I'll say:

c     Snap wingman.

p     or

c     Snap two.

p     Or something. You know, you need a generic word that's good,  
p     because the wingy's going to say "Snap lead," and you don't  
p     want to have to say two words.

e     Yeah.

p     So, some kind of generic word, but snap something, and then  
p     it could come back with a bearing and range.

e     Okay, that's for 5.3.1. Here's what you get:

v     Wingman at nine o'clock, eight miles, line abreast.

p     Okay, just "Two seven zero, eight."

e     Okay, fine.

p     Bearing and range and....

e     Like you mentioned before.

p     Yeah, actually, the standard format we use is called BRAA.

p     B is bearing, R is range, A is altitude, and the last A is  
p     aspect. You know, you could have it give all of that, which  
p     would give me more information about where he was. In this  
p     case, "two seven zero, eight, five." And the aspect is 90  
p     left or 90 right or something like that. I don't know  
p     whether altitude and aspect are all that critical; but  
p     there's bearing and range, without saying "o'clock" and  
p     "miles" would be good.

s     6.1.1

e     After you rejoin with your wingman, you pause to assess  
e     your situation. We're looking for you to request a system  
e     status report. See how things are after the battle there.  
p     How what things are?

e     Whatever you want. What do you want to see? What would you  
e     want to check on?

p Threats.  
 e You want to see what threats are...?  
 p You bet, because what I've done is I've done 180 degree  
 p turn. But what I want to do is I want to find out where the  
 p bombers are, because....  
 e We already know that they're on the way home. Oh, but you  
 e mean more exact positions?  
 p Well, my job is to escort them, that's a two-way  
 p proposition, right? So I want to find out where they are;  
 p and I want to find out where the threats are.  
 e Okay, what about things about your aircraft? The status  
 e report of your aircraft after you've gone through the  
 e battle, that's what we're looking for here.  
 p Well, I'm assuming that I have available what I currently  
 p have in my airplane. I have a display over there that shows  
 p me the ordnance I have onboard and how many of each.  
 e Okay.  
 p And the previous display that you showed me of the  
 p silhouette of the airplane with the different types of  
 p missiles underneath, I assume that's still available...  
 e So you're assuming if there's anything wrong, it'll be  
 e telling you....  
 p What, like battle damage, is that what you're asking?  
 e Yeah. Systems check, just a systems status report. That  
 e might include battle damage or how much fuel you have left.  
 p I want to know where my wingman is; I want to know where the  
 p threats are; I want to know where the bombers are so I can  
 p cover their egress; and if there's something wrong with the  
 p airplane, then I've got caution/warning lights that will  
 p tell me that, and an aual cue that will say "Caution  
 p caution" or "Warning warning" that will focus my attention.  
 p And we don't do battle damage checks until we cross the  
 p FEBA again.  
 e Okay. So you don't have any command for 6.1.1? Let's see  
 e what we can do here....  
 p Well, the handout says "Revision of tactical plans."  
 p I mean, I still want to change this display because I know  
 p my wingman's over there; I want him to join up on me.  
 e This is after you've rejoined with your wingman.  
 p Alright.  
 e You pause to assess your situation.  
 p Then I want to say:  
 o Egress.  
 o Threats.  
 p And then another word to give me where the bombers are.  
 e Let's say when you ask where the bombers are, they're  
 e RTB, they've landed. While you were doing the air battle,  
 e they wiped out the airfield and went home. So they're  
 e drinking beer; and there are no threats out there that are  
 e showing up. So what's the next most important thing?  
 p Well, all the next most important things come after you  
 p cross the FEBA

e Okay, let's say you cross the FEBA then.  
p But prior to getting to the FEBA...it's real important to  
p get your IFF mode four back on, because you're going to be a  
p dead man if you don't. So at some point in here if the  
p airplane is smart enough to remind you....  
e Fence out.  
o Fence out.  
e Defensive.  
p Yeah, that would be really good.  
p Let's say you're able to tell it that a certain INS waypoint  
p is an IP, tell it that another certain INS waypoint is the  
p FEBA, and that when you get ten miles or fifteen miles,  
p whatever preprogrammed thing you want to put in there, that  
p it will automatically say "Fence out" for you. And that  
p would be a cue for the pilot to turn his IFF back on.  
e Alright, let's say we've done all that. So on the other  
e side of the FEBA, mode four's back on. What else?  
p Battle damage check is probably the only other criteria.  
e Nothing, no damage. Anything else you're interested in?  
p What are you fishing for? Tell me what you're fishing for.  
e Well, I guess what we're trying to do is...if your pigeons  
e are homeplate, to use the vernacular, what do you need to  
e know?  
p Oh, you mean, to go home?  
e Yeah, headed home.  
p Okay, well, I guess when I say "egress threats," what I want  
p is my egress routing displayed and then any threats along  
p the route. And when I get up to the FEBA, just prior to the  
p FEBA it's going to display the FEBA and tell me "Fence out."  
p And then once I cross the FEBA...the only other considera-  
p tion...and, again, this really depends on the tactical  
p situation, is do I have egress corridors or safe passage?  
p And, you know, what my status is passing through those.

s 6.1.3  
e Let's just say that you're flying along and this just  
e happens:  
v Minimum RTB fuel; recover at alternate.  
e No tankers are available.  
c Divert.  
p Was that the right word?  
e It's whatever word you want. I was just trying to make it a  
e little realistic.

s 6.1.5  
e Here's what you get: Shows you the bases that are possible,  
e and then we'd ask you to select one of those bases.  
p And so I'd say "divert;" and it would come up, and it would  
p go 1, 2, 3 down here. And I would go:  
c One.  
p or  
c Two.

p or  
c Three.  
p Something like that, and as soon as I select one, then what  
p I want to know is optimum altitude, climb profile, amount of  
p fuel consumed, and all that neat stuff.  
e When you select one, it tells you what you need. Now, the  
e last thing is.... Well, if you could rate those there.  
e 6.1.3 was "Divert." 6.1.5 was the response number, number  
e of that alternate base. What did you ask for when you asked  
e for optimum altitude? Climb profile...?  
p I called for base, and I want to know the optimum altitude  
p to climb to, the maximum range air speed, or Mach, or  
p however you want to display it, and amount of fuel it  
p projects that I will arrive at the base with.  
e Okay, fine.  
p And we can get all that stuff out of our airplanes right  
p now, so we hope that we're not backing up with any of this  
p stuff. This is great.  
e Obviously, we're limited in some of the displays.

e What we'd like to get from you now is a critique.  
e What you think of the way we're doing this.  
p I think you're doing really a good job. I mean, it's hard.  
p None of you have flown fighters, right?  
e Right.  
p So it's really hard going out and figuring all this stuff  
p out without really knowing. I would hope that someone would  
p give you a ride to kind of show you what you're doing.  
e What can we do about it?  
p I don't have the horses to do anything about it, but that  
p would be useful. I would highly recommend going out to the  
p Fighter Weapons School to talk to F-15 and F-16 instructors  
p out there. They're the cream of the crop, and they're also  
p in the forefront of tactics and technology and all that.  
p Also, the 422 Test and Evaluation Squadron...the pilots in  
p that squadron fly every different type of tactical fighter,  
p and their job is to go out and do tactics and weapons  
p testing evaluation. And they are also at Nellis. They're  
p all almost in the same building. Is that everything, or is  
p that one out of two profiles?  
e That's it.  
p Okay, you want to see some tapes?  
e SURE !

End of Transcript - Subject 51

## APPENDIX I

### SUBJECT 45 - Biographical Data Form

Age (Years): 37  
Organization: 157 Tactical Fighter Squadron  
Full time/Part time: Part  
Occupation: Airline Pilot  
Squadron position: Pilot  
Total flying hours: 11,000  
Total jet hours: 8,000  
Total years rated: 15

Specific Aircraft (type, hours): A-7, 2000  
F-16, 500  
other, 8500

SUBJECT 45 - TRANSCRIPT

s 1.2.2  
e Your wingman is in trail, maintaining his position by data-  
e linked information between aircraft. You, as flight lead,  
e are responsible for accomplishing a preplanned rendezvous  
e with two attack aircraft which are also aware of your  
e position via data-link. You have this on your display.  
e Here's you; here's your wingman crossing waypoint two.  
e Then your aircraft reports:  
v Rendezvous data.  
e What are you thinking at this point? The aircraft just told  
e you that it has rendezvous data.  
p Well, I would like to see it, but it doesn't have to tell me  
p that. I'd just soon have it come up there, because I'm  
p sitting here and I know that the rendezvous is coming up.  
p I want to see it displayed as soon as the airplane knows it.  
p He doesn't have to ask me for it.  
e What kind of command would you give if you had...?  
c Show me.  
p Whatever, just have it displayed.  
e Okay, that's at 1.2.2.  
v Sabre 41 at 14 miles closing.  
e Could you rate that there at 1.2.2?  
p When I say speed, I'd say that's poor, because if I was  
p going in there I'd have it set up now where it would be  
p displaying it to me constantly.  
e Okay, fine.  
p So I'd like to see that much quicker. What is conflict?  
e If you had to ask for that by voice, would it conflict with  
e any other voice communications that might be going on?  
p That could be.

s 1.3.2  
e At this point in the mission you're approaching rendezvous  
e and your aircraft has received a data-linked message  
e concerning discovery of new threats down range. That  
e information has come from satellite and JTIDS sources.  
v Threat data.  
e A new ground-to-air threat twenty miles ahead on your flight  
e path, and then, what they're showing here.... What are your  
e concerns and intentions at this point?  
p Again, I want to see its envelope at my current altitude.  
e What command would you give to get more detailed information  
e on that threat?  
c Envelope.  
p Some single word cue that would display to me its threat  
p envelope on this screen right now.  
e Okay, that's for 1.3.2. If you could rate that then.  
p This is assuming that I've got a wingy out there, too,  
p right? That he's getting the same information that I am.  
e Yeah, right.



s 1.4.1  
v Tracking j band.  
e The threat is real and must be dealt with, but you would  
e like to maintain heading until after rendezvous if possible.  
e What are you thinking of at this point?  
p I can't maintain heading if I'm in this guy's threat right  
p now, right? So I still have to know if he's targeted me,  
p if I'm going to be engaged by that site, or else, does he  
p know I'm there? I'd like to know his reaction to me. If he  
p knows I'm there, I can't maintain heading regardless of  
p what's happening.  
e For our scenario, we'd like you to request your counter-  
e measures... You know, to see what your countermeasures  
e options are. Some command for that. We're going to assume  
e that you're going to counter with what you have onboard if  
e possible.  
c Counter.  
e When you say that, you want it to automatically dispense?  
p Well, right now you're telling me...I get the same  
p information now much quicker in the airplane I'm flying,  
p because it shows me just what this has. When I hit a  
p threat, I don't want to counter that threat; as soon as I  
p counter it, everybody in the world knows where I am, and,  
p you've already told me I'm on a sneak attack. The biggest  
p thing I'm interested in right there is:  
o Does he see me?  
p If he doesn't see me, I don't have to do anything. If he  
p sees me, then I've got to either abort the mission; I've got  
p to modify the mission; or, you know, if necessary, I would  
p not engage. Even if I had the capability, I don't know if  
p I'd shoot this guy. That's not what I'm there for. And if  
p I shoot the guy, I've got to get within range for him to  
p shoot me. That blows the whole mission.  
e Does the information help that it is tracking you?  
p That is what I would want to know. It knows I'm there.  
e It's tracking you; it has ID'd you; it knows you're there.  
p Okay, now, I've got to go around him.  
e For our mission, since we couldn't have every case, we're  
e just going to say that you try to counter it, okay?  
p Okay, I'll try to counter.  
e This is showing you what you have onboard. When you say  
e "Counter," would you want it automatically?  
p I don't want.... You can't have the airplane doing that.  
p No, I'd like to command.

s 1.4.3  
e This shows you what you have onboard.  
p Then I'd say:  
c Counter option.  
p So it gives me this. That's an SA-10. I don't know what  
p kind of ECM they got. Do I have the capability of jamming  
p it? That's what I'd want to do.

e What kind of command would you give then to...?  
c Jam.  
e That's the ability for you to command the aircraft by voice,  
e to go ahead and jam them.  
p Okay, that's good. Conflict.... About the same.  
e With the scenario, we're trying to get what you like and  
e don't like. That's the whole idea with this. Say what you  
e think might be easier.  
p On the same token, you know, voice is great, and I can see  
p good applications for it. But you can't imagine the stuff  
p that's coming through the radio on a case like this. While  
p two's back there data-linked, two is probably getting the  
p same information. Two cannot bet that my information is the  
p same as his, so two's going to have to be telling me every-  
p thing he's got on his (display) just like I see on mine.  
p And I can't afford to tell him to shut up, because he might  
p see something I don't. So when this thing's talking to me,  
p my number two man's talking to me; and at the same time my  
p two escortees are going to be talking to me, too. I've got  
p three people at that point in time giving me the same infor-  
p mation; and that's why I'll always generally say the con-  
p flict is never going to be anything better than same. It's  
p always going to be poor because, right now, there's too much  
p verbal communication in the air. This is assuming every-  
p thing's going to work; and we know that in combat situations  
p it's not.  
e That's important to hear.  
v ECM and chaff selected; threat no factor.  
e We had selected the chaff also.

s 1.5.2  
e The threat is no longer tracking your flight as you approach  
e the rendezvous.  
v Rendezvous data.  
e The aircraft has just reported this.  
c Show me.  
p I want to see it. Again, that's poor. It should have done  
p it automatically. Conflict the same.

s 1.5.5  
e Okay, rendezvous is complete, and your fighter is escorting  
e the attackers toward the forward edge of the battle area.  
e As you approach within twenty-five miles, your onboard  
e systems cues fence check:  
v Consent for fence check.  
e Now this is where it could automatically complete the fence  
e check for you based on what you had programmed into the  
e computer before your takeoff.  
p Yep.  
c Do it.  
p I like that.  
v Fence check complete.

e What things might you be looking for in that fence check?  
p That I want all my lights out. The emitters, depending on  
p where I'm going, I want them either up or off. Again, it  
p would depend on the scenario. I'd like all my counter-  
p measures, my ECM, armed and ready to go. I'd like all my  
p missiles.... In this case, since I'm the escort, I'd like my  
p missiles up, armed, and cooled. And I'd like all my attack  
p symbology, my intercept symbology, in the HUD.  
e So it's completed the fence check for you. Do you want to  
e go ahead and rate that?

s 1.6.1

e You're initiating transition to low-level operations: 500  
e knots, 200 feet. The aircraft has full terrain following  
e capability; you need only select values, modes, and check  
e equipment status. What we're looking for here is a command  
e to call that out.

p Okay, the airplane's asked for me to put it on autopilot,  
p essentially, is what it's saying?

e Right now what you're going to be doing is calling up the  
e display for the terrain following radar to set up different  
e values; and you have the choice whether you want to put it  
e on manual or auto. Right now we're just looking for a  
e command to bring up that display so that you could set up.

c Low level.

p Again, that's a poor situation to use verbal commands. A  
p button on the stick would be an easier one to switch modes,  
p just like switching modes on a radar. It's quicker to react  
p to it by hitting a series of switches than it is to sit  
p there and say a name and then have it go through it. Like  
p in the F-16, to switch from the different radar modes, you  
p just start flipping switches. You can cycle through all of  
p them much quicker than you could ever verbalize. What  
p you're doing in any of your nav modes or your attack modes  
p like that, you'd probably be better off doing without verbal  
p because verbal just takes too long.

e Would you have a command for that?

c Low level.

p Or something like that. But, again, it would be quicker  
p just to flip a switch, you know, to hit a button on the  
p stick or the throttle.

e Could we get you to rate that there at 1.6.1?

s 1.6.3

e This is all it brings up, and what we look for now is for  
e you to select which mode...there again, you probably just  
e want to have a button.

p At this time I would not want anything done. I would not  
p want to put the airplane on autopilot. So I would not make  
p any comment because I wouldn't want a verbal comment to fly  
p the airplane manually. The only time I would need a verbal  
p command is if I wanted the airplane to do something for me.

p If you wanted the airplane to do nothing for you, then no  
p comment would be appropriate. You either have to call for  
p SCP 200 or 300, stuff like this you'd want to set up prior  
p to ever going. And an altitude low, I don't know of anybody  
p that, when it's available to us, and it's available to us  
p now, I don't know of anybody that uses it. It's a neat  
p little thing to put in there, but nobody in reality ever  
p uses it. If you're not aware of your altitude at any given  
p time, then you're not going to make it too long anyway.  
e We're just looking for a command there to be able to set one  
e of these two modes. Just what would you say? Just call out  
e one of those names?

p Well, if it's like that, just say:

c Auto.

p or

c Manual.

p If I say nothing at this point in time, what's the airplane  
p going to do?

e Current status that you have there. You're not going to go  
e into manual... If you call manual up on a TF, what it'll do  
e is it'll give you a steering cue on the heads up display.  
p So, in this case, what you're saying...I've got no TF infor-  
p mation in the HUD? Okay, then, yeah, I'm going to have to  
p say something, because I'm going to want to call it up. But  
p again I'm going to have this called up before I enter that  
p arena.

e But you made an interesting point, though: If the  
e computer's smart enough to know that low level's coming  
e up, and it should, it has the mission plan programmed in,  
e there ought to be a default mode so you don't have to say  
e "Manual." It'll assume manual until you tell it "Auto" or  
e something like that. That saves some words. Okay, for this  
e particular mission, we're going auto.

s 2.1.2

e Okay, the low level transmission has been completed, and  
e you're proceeding at two hundred AGL. Threats are on the  
e horizontal situation display. Here's what's on the display.  
e And then your aircraft says:

v Threat data.

e It's indicated a new threat that it feels must be dealt  
e with. What are you thinking about now?

p Well, I'd like to see which of these threats is looking at  
p me. I'd like a whole lot more information on him and the  
p intercept mode. This is essentially RHAW gear now, but I'd  
p like threat information on these guys, if they see me, and  
p intercept information.

e What command would you give to get...?

c Data.

c Threat data.

v Helicopter eighteen miles, twelve o'clock low, closing.

s 2.1.4  
e Okay, this is a Blue Thunder or Airwolf type helicopter that  
e has to be dealt with. What are your concerns and intentions  
e at this point? Now that you know what it is.  
p Okay, I'd like...you already told me he's closing. Do I  
p have any other information that he knows where I am, other  
p than the fact that he's out there and he's closing on me?  
p Or is he just out there lollygagging around?  
e Let's say he knows you're there.  
p If he knows I'm there, then I want a weapon up to kill him.  
e What would be your command?  
p Case like that, it'd be a radar missile.  
c Sparrow,  
c AIM,  
c AMRAAM,  
p whatever, I'd call the missile by name.  
v Master arm on.  
p In this case, when I call for the missile again, I want  
p everything up. I want full missile symbology and intercept  
p symbology everywhere.  
e You want it already to be locked on?  
p I want it to be locked on and ready to fire. If it can go  
p that automatic.

s 2.1.6  
e Could you give us a command for it to lock on? Would there  
e be a situation where you wouldn't want to...you'd always  
e want it to come that way?  
p And then I'd want it to have the option to unlock it.  
p Because I still get more information with the guy locked  
p than I do unlocked, so I want it locked. I want as much  
p information as I can get, and I want it displayed as soon as  
p I call for it. That's when I call for the missile.... I  
p want the missile threat locked, all the information  
p displayed, and then I want the option to bring it off.  
e So we'll skip over 2.1.6 because that's the command to lock  
e it up. How would you unlock it, though, as long as you  
e discussed that?  
p Again, it's quicker to do it with the switch than to try and  
p talk to it.  
e If you could do it by voice?  
p Then I'd say:  
o Off.  
p or  
o Track, track only.  
p Or something like that. But, again, it would be easier...  
p rather than me to have to think of the word, verbalize it,  
p and the computer to interpret it and go to it, just to hit a  
p throttle switch.  
v Radar locked, in range, optimum five seconds.

s 2.2.2  
e Okay, we will assume that you went ahead and shot the  
e missile; helicopter goes down in flames, and you proceed on  
e course through a mountain valley, approaching a lake. Your  
e formation is still intact. But you realize the explosion  
e will now highlight your presence. Here's what comes up:  
v Threat data.  
e What are you thinking now that you see this?  
p Okay, it's the "18" that's the new guy up there?  
e That's the new guy, yeah.  
p I'd like data on him. What does he do? I never heard of an  
p SA-18. I don't even know what he's capable of.  
e This is the future.  
p Well, I've got to know what he can do. You know, can he see  
p me? Can he not see me? So I got to ask for something.  
p Again, when the guy comes up, it would be nice for him to  
p come up with a "Threat data" like that. If it's important  
p enough for the computer to tell me, it's important enough  
p for him to tell me everything it knows.  
e You want that at just....  
p Automatic.  
e Our idea was that possibly you might be doing something  
e else at the time.  
p Well, if it comes up that I'm under immediate threat,  
p whatever else I'm doing at the time is irrelevant.  
e Alright. We hear that both ways, about fifty-fifty. A lot  
e of guys want automatic; a lot of guys say, well, maybe.  
p Well, like I said, you could be doing whatever you want to  
p do. If the guy's an imminent threat to me, I don't want to  
p have to ask for it. I want to see it now, if it's coming up.  
v ECM ineffective, reroute available.  
e That's all it knows about it.

s 2.2.4  
e Your onboard threat manager reports a formidable SAM threat  
e at twelve o'clock. Your ECM is ineffective against this SAM  
e system, and a reroute is suggested.  
c Reroute.  
p That's great! That's the kind of information I need.  
p Because I don't have the time to figure all that stuff out.  
e It's telling you that you'd have to accelerate to 510 knots  
e to meet your time-on-target, if you take this new route.  
e What do you think at this point? What are your concerns and  
e intentions about that?  
p Well, this is based on its information. If that's what it  
p wants to do, then that's the way I want to go, because I  
p want it implemented.  
o Go.  
p or  
o Do.

s 2.2.6

e If you had to give a command to pass that to your wingmen,  
e would you want to give a command to have that data-linked  
e over? Or, when you accepted that, would you want that to  
e automatically be sent to your wingmen?

p No, when I accept it, I'd like it to go automatically. But  
p on the same token, the wingy has got to want to acknowledge  
p that he got it. That he's going to have to query me whether  
p it was my input, or whether his machine just all of a sudden  
p decided to reroute by itself. So you'd have to display on  
p his scope, somehow, this is from me. Because he could be  
p sitting there, get spurious electrons...and all of a sudden  
p he's rerouted out to the boonies. And if it's a data-link,  
p the Soviets can intercept the data-link; and they can  
p reroute him out to the boonies. So he's going to have to  
p know where it's coming from. So there will have to be  
p verbal between me and my wingy. A call, just to confirm.  
p So in that case I'd probably just get on the radio and say:  
c Reroute.

p And then he can look down, and it's automatically there,  
p and his says it's from me. Or, it says, you know, from  
p lead, lead directed or whatever. So now everybody knows  
p that we're operating on the same wave.

e You want to rate that there?

p That workload is good. That's good.

v Message sent.

s 3.1.2 and 3.1.4

e You are proceeding on the rerouted segment of the low level  
e ingress at two hundred feet AGL when your aircraft reports  
e from JTIDS update that a new air threat now exists. You  
e request additional threat information. The horizontal  
e situation display has this. What are you thinking now?  
e What are your concerns?

p OK, outside of 200 miles, fifteen hundred feet? Are they  
p tracking on me? That's what I need to know. I need  
p intercept data on them. Right now, it's all I need. If  
p this is going to happen, I still want to see my ground  
p threats because, right now, these guys 200 miles out are no  
p threat to me; but I've got immediate ground threats all  
p around me, and I cannot afford to go into a pure intercept  
p mode here on my horizontal display and ignore all those  
p ground threats. And if I'm in this mode, whizzing along,  
p and a ground threat pops up, I've got to drop out of this  
p mode. I've got to have the ground threats prioritized  
p because the ground threats at 200 feet on a low-level  
p ingress are my biggest threat, regardless of what other  
p airplanes are out there. These guys at 200 miles are really  
p not a problem to me; they're not going to be a problem to me  
p for about another 8 minutes. So I'm going to ask for inter-  
p cept data on these guys because now this is.... I'm looking  
p down the road now, because the distance out.... And however

p far, I'm assuming I'm getting close to the target, and I'd  
p be willing to bet my intercept's probably going to occur  
p somewhere near the target, but I have still got a formidable  
p ground threat to run through, so the ground threat at this  
p time is still my primary concern. And I don't want all my  
p systems going into an air-to-air mode when I've got SAMs  
p ahead of me that I've got to see.  
e In this case, what we're going to do is we're going to ask  
e you to go ahead and go in that air-to-air mode. Reason  
e behind it is that we've been dealing with some of the air-  
e to-ground issues, up to this point. Now we want to deal  
e with a little bit of air-to-air issues, get some voice  
e responses for that. Although it is a little unrealistic,  
e we're going to ask you to sort of....  
p So I can ignore my SAM rings now.  
e You can ignore that. We're making assumptions in this case.  
e You don't have to deal with those at this point in time.  
p Well, unfortunately, the assumptions you make here is the  
p way the airplanes get designed. And now I'm out there in  
p combat; I try to go to a different mode, and it drops every-  
p thing else that I had, and I'm out there in the dark. On  
p this airplane, it's beautifully designed for simulation like  
p this, but in combat it becomes a problem. So that the  
p computer's deciding what it's going to show me at any given  
p time, which is really not what I need to know at that  
p particular time.  
e What if ground threats after that reroute, somehow, jumped  
e over the valley.... So you felt fairly confident.  
p Now these guys are my primary threat, and my concerns at  
p this point in time are: one, not engaging them; and, two,  
p not letting them engage my attackers, my bombers. I'm going  
p to ask for intercept data.  
e What we'll next look for is asking you to set up BVR.  
e Set up your aircraft...  
p And, again, the way I'd like to see it done.... At this  
p point in time, my ground threats are gone. I'm going to go  
p to the air threat. So I'm going to ask for my radar  
p missile: my sparrow or AMRAAM or whatever. When I ask for  
p that, I'd like my systems reprogrammed. I want my RHAW  
p gear, since I'm no longer facing the ground threat, I'd like  
p my RHAW gear to come up to an air threat...all my ECM. I  
p want my flares on now because I'm going to be facing an IR  
p missile, maybe, and I'd like my chaff up. And I'd like any  
p programmable ECM to go to the radar that I'm going to be  
p facing, i.e., the airborne intercept radar. And I want the  
p missile up; and I want intercept symbology in my HUD.  
e You just call it by the name of the missile.  
p Call it by the missile and all that would happen.  
e That's 3.1.2. Specifically, if you had to remode your  
e cockpit from air-to-ground looking to an air-to-air looking,  
c how would you do that? By calling a missile?  
p Well, you know, I say that now, but on the same token you



p can never be sure that you're out of the ground threat. So  
p you'd still want your ECM.... You'd have to be able to bring  
p that back up to face the ground threat. You'd have to be  
p able to bring a HARM back up if you got something launched  
p at you. Really, to reconfigure the cockpit in this particu-  
p lar scenario, what I'd do is I'd ask for intercept on the  
p HUD and the radar missile up because I want to take the  
p earliest possible shot. And the self-defense of the ECM  
p would probably pretty much stay in the air-to-ground mode.  
e 3.1.2 is requesting the configuration of aircraft for the  
e air-to-air BVR.  
p Again, it'd be easier just to flip a switch.  
e 3.1.4 is selecting the missile.  
p All that would be the same because I'd want all that to  
p happen simultaneously.  
v Configured air-to-air.  
v Master arm on.  
e You've got that all set up.

s 3.1.6  
e We haven't ID'd those guys, yet. And we have on this air-  
e craft an infrared search and track sensor that can get  
e information on them. What command would you use to call  
e that up?  
p You want to use the IR search and track as an ID method?  
e We don't want to highlight your presence yet by using your  
e radar, because it's not a passive sensor.  
p Well, alright, then:  
c IR.  
p That other information was data-linked from somebody else?  
e Yeah.  
p So I don't have sensors on them yet?  
e Right. So now you're going to turn your infrared on, your  
e passive sensor. You don't want to turn your radar on yet,  
e for some reason, let's say. Here, this is what you get.

s 3.2.1  
e This is what the display looks like. TheIRST shows four  
e infrared heat sources, 22 degrees left and 20 degrees high.  
e And JTIDS information estimates their range to be 185 miles.  
e What kind of command would you give to try to ID those guys?  
c ID.  
p Simple as that, and take whatever it can to do it. Do it  
p off of data-link or do it off of a heat signature. Looks  
p good.  
v Hostile.  
p That's all I need to know.

s 3.2.3  
e This sensor also has capability of getting a closer look at  
e the targets. What kind of command would you give to...?  
c Expand.

c Close up.  
p You're getting into an area now that you're spending too  
p much time thinking about what you're going to talk to the  
p airplane. You're interacting with the airplane too much at  
p this time. In a situation like this, now you're in here.  
p You're looking down, and you're thinking about talking to an  
p airplane instead of just out there making the airplane do  
p what you want it to do. The airplane has become somebody  
p you're talking to, which is dangerous. The airplane should  
p disappear in a situation like this. You should not even be  
p aware that the airplane is there. You ought to be doing  
p things...reacting to outside stimuli without consciously  
p manipulating an airplane; and this forces you to always look  
p and react with the airplane or to the airplane.

s 3.2.5  
p Okay, so I've expanded, I've got a four-ship.  
e We have also capability of getting a track analysis on....  
p Well, the intercept. All that should be with the intercept  
p data. I should see their headings because I got that now.  
p I don't have to ask for anything, and this is a giant step  
p backwards if I have to ask for each piece of information.  
e If you had to, what command would you give?  
c Track.  
v In range for air-to-air radar.

s 3.2.7  
e Okay, it's got the track. And so now that you're in range  
e for your air-to-air radar, what command to select that...?  
p That I'd ask for:  
c Radar.  
p At this point in time I wouldn't assume just because I'm in  
p range I need it. I'm here because they can't detect the  
p fact that I'm looking at them. I don't know if they know  
p where I am yet. By the way the track's heading, they  
p obviously.... They may or may not know I'm there so I'd keep  
p the radar off at this time. What I would like would be an  
p radar missile in-range cue. So if all of a sudden I'm in  
p range for the radar missile, my longest shot, it can tell me  
p "Radar missile in range." Now I can say "radar," have  
p everything locked up and shoot. So the first time that they  
p know I'm there is I light their RHAW gear up with my missile  
p in the air.

s 3.2.9  
e Showing you four MIG-39's. That's what it determined they  
e are. Your onboard air battle management system has computed  
e optimal intercept profiles. These intercept options are  
e available upon request.  
p I'd ask to see it.  
c Optimum.  
e And you get this display.

p That's probably good.

s 3.2.11

e Intercept option one, due to its priority number, has a  
e shorter time to engage but a lower PK, about 0.5. While  
e intercept option two is more conservative but offers a much  
e higher PK, about 0.98. What are you thinking at this point?  
e Having that information, is that useful or useless or...?

p Yeah, it's good. But it gives me something else to think  
p about. That decision would have been made for me in this  
p scenario earlier on. Right now, option one is the only way  
p I can go because I've got to keep these guys off my  
p strikers. If I'm going to engage, I've got to engage the  
p absolute quickest I can. You know, PK is irrelevant. I'm  
p not interested in killing them; I just want to keep them off  
p my strikers. So, in this case, yeah, it'd be nice to know  
p (the optimum intercept). And there are times, if I know  
p that my strikers have hit the target and they're exiting,  
p now I'd probably look at option two. I know they're pro-  
p tected. They're gone; and I can go for the higher PK kill.  
e What command would you give to select an option, then?  
p If I select the option, what's the airplane do? Is the  
p airplane going to fly it by itself?  
e No, you're going to fly it; it's just giving you the  
e directions.

p Well, you just call for it by the number. You know, you're  
p flying the airplane through command steering. You're in the  
p wrong position because you fly the airplane from command  
p steering by looking at the airplane. The airplane should  
p not even be a factor; you should not even be aware that  
p you're sitting in the airplane.

e You mean you don't want to use your HUD, right?

p But you're going to be doing it because you know that  
p they're here, and you're going to be flying out over here.  
p You know, you're not flying headings and altitudes and air  
p speeds, what you're doing is you're putting yourself....  
p And you've already visualized this arena in your mind, and  
p you're flying to it. Well, yeah, you call for whatever  
p option he shows up there. And call for that, and if that  
p appears in the HUD, fine, but the guy that flies it into the  
p HUD into there.... And we'd do it now, you get guys that are  
p flying an intercept, heads down, doing it by the book, and  
p they enter the merge and can't figure out why they don't see  
p anybody. Well, shit, they don't look outside until they're  
p three miles out; so that's way too late. Because they're  
p flying a simulator all the way into the merge. You can't  
p get away with that.

e So, what was your command again?

p I'd call for whatever option you give.

c One.

p or

c Two.

p Usefulness is poor, the workload is good.

s 3.2.13

e In this case, we're taking option two.

p Okay.

e And it displays that. Would you want that automatically  
e sent to your wingman? Or would you want to have a command?  
e We're looking for a command to send it up.

p Well, I'd like it automatically. I'd like this to show  
p automatically, but, again, he's going to have to either  
p acknowledge received or I'm going to have to come over the  
p radio and say that it's being sent, and I don't want his  
p stuff slaved to me right now.

e Okay.

p Because his advantage to me is he's another set of eyes and  
p another set of sensors, so I want that displayed to him to  
p know this is what I'm going to do without having to say,  
p "Okay, we're going to split, split right, single side  
p offset. Go shoot or cover." Probably going to end up  
p having to say that anyway, and that's the way I'm going to  
p be displaying it, because I'm going to say "single side  
p offset right," and he's going to see that, and he's going to  
p know that that was the option that I sent him.

e Okay, if you had to send that command, what would you give?  
c Send it.

e Alright.

v Message sent.

s 3.2.15

e You're committed now against the air-to-air threat, but  
e you're concerned about the attack flight and request an  
e update on their progress. What kind of command would you be  
e giving there to find out where they're at or what their  
e situation is; or would you even be concerned about doing  
e that at this point?

p Well, again, if I've committed to the longer time optimum  
p kill, I've obviously said the strikers are on their own, so  
p I would probably not be concerned with them. At this point  
p in time, if I was still escorting strikers, I would not have  
p committed to this kind of attack. But, yeah, it's nice to  
p see, just call for strikers. Again, why should they have  
p ever dropped off the screen? I wouldn't even have gone to  
p the intercept mode. I'd still like to see where my strikers  
p are, because those are the guys I'm protecting.  
e So your command would just be...?

c Strikers.

p But it's a useless command, they should always be displayed  
p there, in a case like this.

e What if, for instance, you had it off for declutter? You  
e just wanted to get some of the clutter off...filled with  
e targets, and your friendlies were just something else  
e cluttering up the screen, and you had the capability of

e decluttering it. That's the type of thing I was looking at.  
p I can't imagine any time, if this is my primary view of my  
p environment, I can't imagine any time that I would ever  
p declutter. Because if I declutter, the second that I  
p declutter the guy that I say is not a factor becomes a  
p factor. Either he becomes a factor because I run into him,  
p or he'll become a factor because all of a sudden he'll turn  
p and come back at me. You know, you get the same thing in  
p the RHAW scope, where they say you can declutter the RHAW  
p scope. I can never see decluttering the RHAW scope, because  
p I've got to know, and if I can't keep up with it, then my  
p chances of survival are slim or none anyway. But in a case  
p like this and in an airborne threat, I want to see all the  
p airborne threats at all times, or all the airborne airplanes  
p at all times. Because, again, I say I could run into them,  
p as well, if I don't know they're there. Coming from inside  
p out, looking here at low altitude, and there's a helicopter  
p that's a cargo helicopter, that the airplane said it's not  
p important, and all of a sudden I look up, and I'm filled  
p with cargo helicopter, I just ran into them.  
e Could we get you to rate this?  
p Speed.... It should already be there.  
v IP inbound.  
p Well, that could display, too, because now I can see where  
p these guys are going to go. If these guys keep blowing  
p through, they're obviously not after me. If they're good at  
p what they're doing, they're going to be going for the  
p strikers, they're not going to be paying attention to me.

s 3.3.1  
e You are assured now that your responsibility is to attack  
e the air threat and allow the attack flight to initiate their  
e battle area tactics and bomb the airfield. We ask for you  
e now to request a vector towards the strikers. Would you  
e want something like that? Would you be requesting a vector  
e at this point?  
p No, not if I knew where they were. If I knew where they  
p were, I'd be doing it.  
e We're just looking for you to request an intercept vector  
e towards these bandits.  
p I've already got that here, don't I?  
e Say you were asking just for an intercept vector....  
p I'd ask just for:  
c Vector.  
p That's what I'd want.  
e Like GCI.  
p Yeah, I'd just talk to it like I would GCI. I'd ask for a  
p vector. But, again, that should be there, I shouldn't have  
p to work for that.  
v Vector 060.  
p Okay, now what is this telling me? This 060. Is this 060  
p off my nose, or is that a compass heading?

e Let's say off your nose.  
p Again, I have that. I'd see it right here, if this thing is  
p positioned according to my nose, I know they're over here.  
e Right.  
p I've got that information even in my primitive little air-  
p plane now; it's already there automatically. That sort of  
p information should already be there. If you're asking me to  
p ask for stuff that I've already got, you're slowing me down.  
e That's the kind of comments we're looking for, whatever you  
e like or don't like.

s 3.3.3  
e The next command we're looking for is for you to request  
e that your wingman deploy. Would you expect him to have  
e already been deployed? Or would you be doing that?  
p Yeah, well.... Still back there, probably a mile and a half,  
p two miles off with me in a shooter-cover formation. Now we  
p see these guys, and if I'm going to attack them, I'm talking  
p to him verbally because I can't count on any data-link going  
p out there. I'm talking to him verbally, and he's going to  
p confirm that he has these guys. He's going to confirm that  
p they're in this formation, and I'm going to say fine. We've  
p expanded. I'm going to say "I'm going to take the trailing  
p man here; monitor the right-hand or the left-hand man." So  
p what he's going to do is he's going to be paying attention  
p to this pair, and I'm going to be attacking this pair. And  
p he's going to be with me right now. So I'm not going to  
p tell him to do anything, and I don't want anything.... If I  
p direct my wingman to do something like that, I'm going to  
p direct him over the radio; the airplane's not going to  
p direct him to do it.  
e Okay, how would you say it over the radio then?  
p In a case like that, if I want him to deploy, I'll tell him:  
c Deploy.  
p And that will tell him, again, because we've briefed it  
p exactly where I want him.  
v Message sent.

s 4.1.2  
e And now we're moving into prioritization and target  
e assignment. Here's what's on your display, and your  
e aircraft tells you:  
v Target assignment ready.  
e The computer has come up with a target assignment. It's  
e asking you if you want to see what it is going to assign to  
e you. What it thinks is the best....  
p Oh, the computer's going to do it. Yeah, I'd like to see it.  
e And what would your command be?  
c Target.  
p But, again, I would have already had in my own mind how it's  
p going to run.

s 4.1.4  
e You always have the override, too; you don't have to accept.  
p So it agreed with me. I'd say okay, that's what I want.  
e What would your command be at this...?  
c Accept.  
v Message sent.  
e Passes information over, accepting the target assignments.

s 5.1.2  
e As your wingman moves out to line abreast, the enemy begins  
e to maneuver and appears to merge. As you close within 35  
e nautical miles, the onboard system reports a target split.  
v Targets cross.  
e The targets numbered "1" appear to be converging on your  
e flight; and targets numbered "2" are attempting to separate  
e toward the airfield and go for the attack flight. What are  
e your concerns and intentions now?  
p I'm 30 miles out. Two might have a shot. Does two have a  
p shot yet?  
e No, pretty soon.  
p Pretty soon? Well, two's targeted on the pair going for the  
p strikers, but he's going to be under attack by the other  
p pair. Well, my concern is the pair going for the strikers.  
p But I cannot ignore the lead element.  
o Tell two to drag in, and I'm going to take the shot on lead.  
p And, you know, with the data-link, he'll still be able to  
p see these guys over here. But when I tell him my missile's  
p in the air, he can pitch back into the fight and take out  
p these guys before they hit the strikers. But there's  
p nothing I need to tell the airplane.  
e What we're going to do in our scenario is we're going to  
e reassign target number two to you own flight and target  
e number one to wingman.  
p Okay, because that would be another way of doing it.  
e If you could do that, what kind of command would you give?  
c Switch.

s 5.1.4  
e Would you want that automatically to go to your wingman?  
p I'd have to call that simultaneously.  
e How would you do that?  
p By telling the wingman to:  
c Switch.  
p And he would understand that, too. And I'd say "switch;"  
p and, hopefully, by even transmitting "switch" the computer  
p would accept it and my wingman would know it. His display  
p would change, and now everybody knows that it's a valid  
p switch. Again, unless the wingy hears me, or I hear my  
p wingy and I recognize his voice, I can't bet that it just  
p didn't do this automatically, and he can't bet it either.  
e Then you'd get:  
v Message sent.

s 5.2.2

e Now your aircraft reports:

v Target in range in ten miles.

e Okay, it just told you that. Now what are you thinking?

p If he's in range, I want missiles in the air.

e It said he's in range in ten miles.

p He'll be in range in ten miles, but that's just advisory

p only. You know, again, I should have everything up, right?

p I've got shoot cues on my missiles.

e We don't have that up yet, what we're looking for is you to  
e request preparation for firing at two targets. And have two  
e missiles ready to go at once.

p Well, I wanted that done when I made the targeting, so I'd  
p want that up now.

e How would you get that?

p I've already asked for the sparrow or the AIM-7, so that  
p should be it. And when I said "targeting," that was when I  
p wanted the missiles to follow through.

v Master arm on, radar locked, in range, optimum five seconds.

p Now I'm looking at shoot cues, and I'm going to take the

p shot. In this case, that head-on shot. I would have taken

p the the longest shot I could take, beause I want to fire my

p missile first. In the case of the strikers, or the guy was

p not running at me head-on, I would wait till the optimum

p part of the envelope, the high PK shot. But, again, that's

p what I would be watching through the shoot cues. Again, the

p airplane wouldn't need to tell me that. I need to see that

p as a continuous readout. I don't need verbal commands for

p that. And it's just a question of PK's, that's all you're

p looking at; and it's a question of what you want to do. You

p know, if I want to scare this guy out there to force him to

p react, I'm going to take the absolute longest shot I can,

p knowing that as soon as that missile's in the air he's going

p to have to do something, and he's no longer offensive. He's

p now defensive, which might be all I need to do. I just

p might need to turn them away so they leave my strikers

p alone. Or else, if I'm going to attack, or I've got nothing

p else to do and my job is to kill him, then I'm going to

p press for the closer shot because I don't want him coming

p back at me.

s 5.2.4

e You and your wingman fire two missiles each and disengage.

e You cover your egress with chaff and flares. What kind of a  
e command would you give to request chaff and flares?

c Chaff.

c Flares.

p In our airplane (F-4), "chaff flares" verbally is good. If

p the airplane was set up properly, it would not be good. It'd

p still be quicker to do it with the switch, but the way ours

p is set up...again, some engineer stuck it up there.

v Dispensed chaff and flares.



s 5.3.1  
e The attack flight has knocked out the airfield, and is  
e returning to base. Targets have been destroyed, and you are  
e safely out of the battle area. Now you request some rejoin  
e information with your wingman. You know, he'd been fighting  
e over here. What are you thinking about, and how would you  
e get that information?  
p Instinctively, even out from the battle, he would know  
p approximately where I am; and if he can get all the data-  
p link stuff, the only thing he needs to know is know where I  
p am. Again, I wouldn't have to ask anybody for that or  
p anything else. If I can see that he's over there, that's  
p all I need to know.  
e Let's say you guys got separated.  
p But on my display, don't I still see...isn't he still data-  
p linked to me down there? I just need to know which side of  
p the airplane he's on. He might be over there thirty miles,  
p and I can say "I'm 30 miles west of you." He can look for  
p me on his screen, too. He doesn't need vectors to me or  
p anything like that, if he knows approximately where I am.  
e That's the display like that all the time.  
p You know, that's my air situation display, that should be  
p there all the time. I've called, you know, for all these  
p multitude of things: missiles up, intercepts on, and all  
p this, and I shoot my missiles. What happens? Am I left in  
p those modes? How do I bring myself down?  
e How do you want to bring yourself down?  
p I don't know; that's what I'm saying.  
e If you were to do it both ways, would you go through a  
e checklist? Would you go through a fence out type of thing?  
p Yeah, you'd want to do a fence out. At this point in time,  
p you're still in a hostile area, so you don't want to go  
p fence out yet. Well, in this case, you'd leave yourself in  
p the intercept modes because you're no longer worried about  
p ground threats.  
e Let's step the scenario up a bit here. You've gone past the  
e FEBA; you're back in friendly territory. What are you going  
e to...?  
p If I'm in a peace-time environment, then I'd call for  
p something like:  
o Fence out.  
o Nav.  
p And I'd want all my chaff my ECM, and all that in the  
p passive, standby modes, and I'd want...I wouldn't want my  
p missiles up. The horizontal displays would be navigation  
p information, and I'd want my radar and the air-to-air inter-  
p cept modes. So at least I can see what's out in front of me.  
e What I thought I heard you say is you'd like something  
e automatic after the fight to bring back the displays that  
e are important to you.  
p Yeah. They become very specific real quick, and you don't  
p want things that specific even in that area, because when

p you go to the intercept and all you see out there are your  
p targets...well, that's no good to you. You've got to see  
p where everybody else is. If you can see your radar in the  
p 360 degree radar display, the horizontal, is great, because  
p that's what limits us now. If you can get data-linked where  
p he is, your situation awareness goes up tremendously. But  
p that sort of stuff should be there all the time, and it  
p should never go away. And that would be important enough to  
p me to have a separate screen that would have nothing but  
p air-to-air display on it. All the airborne airplanes within  
p the scale of whatever you're looking at should be there all  
p the time, and you'd have another display for your specific,  
p intercepts, the ground threats, your RHAW scope displays,  
p and stuff like that. The overall, God's-eye view of the  
p arena should be there all the time.  
e Would you want the ground threats on that one?  
p Nope, I want the air-to-air arena there. If I'm interested  
p in ground threats, then it's important enough to me to have  
p a map on the ground showing ground references with ground  
p threats on it. I need the God's-eye view of the air-to-air  
p arena all the time.  
v Wingman at nine o'clock, eight miles, line abreast.

s 6.1.1  
e After you rejoin your wingman, you pause to assess your  
e situation. Your system tells you this:  
v Minimum RTB fuel; recover at alternate.  
e The system's determined this for you.  
p If I have to wait for the airplane to tell me that, I'm in  
p sad shape. That's something you do instinctively all the  
p time. But, it's nice to have it say whether I recover at  
p the alternate or not. But I get that information now in my  
p own airplane and it doesn't need to be a verbal warning. My  
p bingo fuel is set; and when I reach that I get a flashing  
p light to tell me what that just what told me. I either  
p recover at the alternate, or I've got to do something else.  
e There are no tankers available or anything. So we want you  
e to request a display that shows the alternate bases.  
p That'd be part of my nav function.  
e You'd want that to come up automatically also.  
p Well, I should be in the nav function now, right? If I'm in  
p the nav function, my horizontal display would show ground  
p map references. Hopefully, it would show all the airfields  
p in its display. Did you ever see the cockpit of a 757?  
e Yes.  
p That kind of nav is what you'd want in a nav display, where  
p it shows everything in the world: It gives you your course  
p lines and possible course lines and TACAN stations and  
p airfields and highways and cities and everything else.  
p That's what you'd like to see in something like that, and if  
p you ask for alternate bases, then it could just flash  
p selected bases. But you're going to know where they are

p anyway. You're going to know where your bases are simply  
p because that's part of your business.

s 6.1.3

e This shows you the different bases that are available, rated  
e on different criterion, like whether it has fuel or weapons  
e that you need to re-arm your aircraft, maintenance,  
e whatever. If you had the choice of selecting one of those,  
e how would you select it, and what would you like the  
e criterion to be based on?

p If I'm fuel critical, then I could care less what ordnance  
p it has or anything else. I got to put the airplane down.  
e Let's assume that you can reach any three of those with the  
e fuel that you have onboard.

p I would know that before I ever walked out the door. I'd  
p get that in the mass gaggle briefing or whatever it was; and  
p I can't see where in the airplane that would switch on a  
p daily basis. I could not make that decision without going  
p to somebody else. I'd have to talk to a command post and  
p say, "Here I am. Where do you want me to land?" And if it  
p was a question if I could reach any of those three fields,  
p then it would not be my decision where I would land; it  
p would be somebody else's.

e Okay, let's say that they tell you. They come back with:  
e "Why don't you land at Rhein-Mein." How would you tell your  
e aircraft that you would do that?

p Wait, why would I need to tell my airplane that?

e Well, the airplane has calculated three possible bases. It's  
e telling you that it can give you a route or vector to any  
e one of those three. When command post tells you to go to  
e Rhein-Mein, you respond to the computer to identify it. You  
e can drop the two other alternate bases. Gives you a climb  
e profile, optimal altitude, optimum airspeed, etc.

p Okay, you can do that. But, again, I can do that now; and I  
p do it with a thumb switch every bit as easily as doing it by  
p voice. If you got to do it, that'd probably be as good as  
p any.

e Now we'd like you to give us a critique, overall, verbally,  
e you know, what you think about voice and what you think  
e about the method we're doing here.

p Voice in the cockpit is good because it can alleviate a lot  
p of your workload; but you have to be careful when you start  
p conversing with your airplane. That that's not all that you  
p do, because there will come times, like I said, when you  
p initiate the attack, you cannot afford to be conscious of  
p the airplane. The airplane has to just disappear, and it's  
p like you're flying in a bubble, and if you're constantly  
p having to react with the airplane, then you're defeating the  
p purpose because you're required to do it consciously.

e When you set up a certain thing, you want a lot of things to  
e be done automatically....

p Automatically, that's right, and like your intercept....  
 p When I ask for the missiles to come up, you know, I'm  
 p committing myself at that point in time that I am going to  
 p attack this target, and if the missiles are off, I want  
 p everything up. You know, I want the intercept symbology up.  
 p Whatever, some way of telling the computer which target I'm  
 p going for; but I would probably be doing that when I've  
 p brought all the missiles up. That's the way I do now, and  
 p I'll sit there and watch everything in my normal air-to-air  
 p mode. And then when I commit, I bring the weapons up, and  
 p now everything turns intercept, and I'm gone. And then I  
 p don't have to do anything else with the airplane. And  
 p that's the way I would envision that. Some of the nav  
 p features, you know, it's gee-whiz stuff; but if you're just  
 p in a nav mode, you're not time-compressed anyway. You have  
 p plenty of time to talk to the airplane. You can make it as  
 p gee-whiz as you want, but in the attacks, you want to avoid  
 p forcing the pilot to react to the airplane because the pilot  
 p has to react to the external threat, and anything that would  
 p internalize the pilot's attention is going to kill him.  
 e Seems like a shut-up switch basically when you get into the  
 e attack mode.  
 p Oh, not so much a shut-up switch. The threat warnings that  
 p you get in the heat of battle would be nice to come across  
 p aurally.  
 e For missile launch.  
 p Yeah, for missile launch or a bandit call in your ear. And  
 p now when you're sitting there and you're channelized outside  
 p and you get a bandit call in your ear, you know somebody  
 p else has just picked you up. You know the airborne radar  
 p has just entered the arena, and you either look outside  
 p there or you could come back to your normal God's-eye view  
 p down here and see who the new guy is down there, and now you  
 p know that there's another player in the arena. Once you  
 p commit the attack, you don't want to be interfacing with the  
 p airplane as an airplane. In a lot of cases, that's what  
 p we're doing here.  
 e You'd like that just as warnings...  
 p Yep.  
 e Bandit, ground threat.  
 p Right. But to call the weapons up is great. You know,  
 p that's nice, too, but in a lot of cases it's easier and it's  
 p quicker to have it all on throttle switch or stick switch,  
 p because if I'm sitting there and I'm thinking about, "Well,  
 p I've got to go to AIM-7." By the time I think about it,  
 p I've done it. But if I have to say it: "Oh, I got to go to  
 p AIM-7, okay, 'Sparrows.'" Airplane says, "Roger Sparrows,"  
 p and I've just lost a couple of seconds, which may or may not  
 p be important. But it may be real important if you're coming  
 p in.... You've missed your close in missile shot. Now you've  
 p closed from the heat range to gun range, just like that.  
 p It's nice just to be able to flip it outboard, and now

p you're immediately in guns, rather than sittting there and:  
 p "Oh, shit have I missed? 'Guns!'" "Roger, guns" and now  
 p you're inside guns parameters. You've got avoid hitting the  
 p guy. Like we do, heat and guns come up at the same time.  
 p The design of the display is what's going to be important.  
 p You know, the verbal is good; but, again, don't get so  
 p cosmic that you're forcing the guy to react....to converse  
 p with the airplane when he should not have to be conversing,  
 p Again, these are designed in the simulator. You design  
 p these things in a simulator, and the simulators are great;  
 p but the simulators do not simulate the outside world. And  
 p you tend to fly simulators inside, because that's where  
 p everything is. That's where everything's happening, inside;  
 p but, in an air-to-air arena you do not fly inside. If you do  
 p fly inside, you don't live long. You've got to be outside.  
 p And if you can do these displays and HUD's, drop the  
 p combining glass. Get the combining glass out of there, and  
 p display all the information on the canopy itself.  
 e That's the concept.  
 p Well, that's the way to go. Even now, you know, I've got to  
 p come back and, again, channelize on the airplane. Internal-  
 p ize to look at stuff on the HUD because I've got to find the  
 p combining glass and look at it. If I can just swing through  
 p the canopy and see the symbology as I go through, I don't  
 p have to internalize at all.  
 e Like helmet mounted type....  
 p Yeah, but helmet mounted displays.... Yeah, but what happens  
 p there is it tends to put blinders on.  
 e How so?  
 p Well, you've got something there that's sitting on your  
 p head, and the ideal helmet is a space suit, the old Buck  
 p Rogers fish bowl on your head. That's what you'd like to  
 p see, where you can turn your head anywhere you'd want to  
 p look. Even the helmets that we have, you lose about that  
 p much of your peripheral, which, again, is not much. There  
 p are alot of flashes out here that, while I can't determine  
 p what they are, catch my eye. You know, that's all you need  
 p from a smoke trail or something like...see that coming up at  
 p you. So helmet mounted displays tend to restrict vision;  
 p and the less restricted you can keep the vision, the better  
 p off you are, because, again, it's an outside fight, even for  
 p the ground threats.  
 p So I would look it to have, say, four basic screens that you  
 p would look at: (1) You'd have your basic nav screen, which  
 p is a 757 nav mode, and that's what you'd look for in a nav  
 p screen. (2) You'd want your attack screen. Your low  
 p altitude or ground attack screen, which would have your nav  
 p screen with threat rings, and have your RHAW integrated into  
 p that particular screen, where now you see your nav routing  
 p plus your threat routings.... The 3D, where you could see  
 p vertical threat envelopes and that all incorporated with  
 p your RHAW gear so that, at any given time, if one threat is

p active, as you look on that screen, you can tell which is  
p the active emitter at that point in time. (3) And then you'd  
p want your airborne view. (4) And then you'd want your pure  
p intercept. That would take three screens because you'd  
p never be in the ground attack mode while you're in the  
p intercept mode. So you'd have your nav mode here that would  
p be constant. You'd have your attack screen here for either  
p air-to-air or air-to-ground. And then you'd have your  
p God's-eye air-to-air arena. And, essentially, your nav mode  
p is your God's-eye air-to-ground arena. That'd be the way to  
p work it. And you could verbally call weapons up or change  
p to the attack screen: either air-to-ground or air-to-air.  
p However you want to do it, customize it. That would be the  
p ideal way to go.

End of Transcript - Subject 45

## APPENDIX J

### SUBJECT 35 - Biographical Data Form

Age (Years): 30  
Organization: 177 Tactical Fighter Training Squadron  
Full time/Part time: Full  
Occupation: Fighter Pilot  
Squadron position: Instructor Pilot  
Total flying hours: 1000  
Total jet hours: 900  
Total years rated: 5

Specific Aircraft (type, hours): F-4, 700  
A-4, 100  
T-2, 100  
T-34, 100

SUBJECT 35 - TRANSCRIPT

s 1.2.2  
e Your lead of the escort flight, for the attack flight.  
e You're going to rendezvous before the FEBA, go low level  
e through this mountain valley. The attack flight's going to  
e go wipe out that enemy airfield while you go do a BVR air-  
e to-air battle. You're getting information from satellite,  
e JTIDS, data-link between your element and among the whole  
e formation, there. And you get info from AWACS, too. So  
e we'll assume that any information that you get from the  
e outside is good because you have high confidence in the  
e system. Whether you really do or not may be another story.  
e So that's the overview of the scenario; let's begin.  
e This mission begins with your twoship of fighter aircraft  
e descending through 5000 feet and 0.85 Mach, in the weather.  
e Your wingman is in trail, maintaining position via data-link  
e information between aircraft. You as the flight lead are  
e responsible for accomplishing the preplanned rendezvous with  
e two attack aircraft which are also aware of your position  
e via data-link. And your horizontal situation display looks  
e like this now. You're in blue, your wingman's in green  
e there, and you're just crossing waypoint number two.  
p OK.  
e A few seconds after that, you get a data-linked message from  
e your airplane that says:  
v Rendezvous data.  
e And what that tells you, based on your training, is that the  
e airplane has received some information on the rendezvous,  
e but rather than spit it all out at once, it prompts you.  
e It says "I have this information," and it waits for you to  
e ask for details. So given all that info I've just talked  
e about, what are you thinking?  
p Well, what do you mean, "Rendezvous data?"  
e OK, it has information on the rendezvous.  
p It wants to give me something?  
e It wants to give you something, and that's how it says it.  
c Display horizontal position of attack element.  
e You're looking for more information, then. If you could  
e fill out the boxes there, please.  
p OK, what do you want me to do?  
e You're comparing the ability to say what you just said and  
e get the information you want versus the normal way you'd do  
e it, which in this case would probably be a radio call to the  
e attack flight, right?  
p OK, it didn't do anything yet, though.  
e That's because I don't want you to evaluate the display, I  
e want you to evaluate voice.  
p Being able to get instant feedback?  
e Yeah, compare voice to the normal method you have for  
e getting that, which would probably be a radio call. So it  
e wouldn't be a whole lot different, probably, but....



p Probably be the same. Conflict?  
 e Whether anything else is going on in the cockpit that would  
 e affect getting that job done.  
 p Probably the same. Workload, usefulness...same.  
 e OK, and what you get is:  
 v Sabre 41 at 14 miles closing.  
 e OK, that's the display.  
 p If I'm getting this in the cockpit, that's fine. But if I'm  
 p not looking at that...  
 e Well, that's why it came over with the voice, too, telling  
 e you where they were.  
 p It'd be nicer to hear "Three o'clock, fourteen miles." It  
 p would be nicer to hear the position and the range, rather  
 p than just range. If I'm looking at my wingman, while I'm  
 p doing this, and, obviously, the ideal thing about this is,  
 p so I can look around with a voice and say "Where is the  
 p strike element?" And it says "Fourteen miles." Well,  
 p that's great! That's like having a backseater say "I've got  
 p somebody." See what I'm saying? But I also need bearing.  
 p Is he in front of me? Is he on the left or right side?  
 e You'd like it to say "Four o'clock." That's a good point.  
 p Where, if I'm looking at my wingman, I'm checking six, and I  
 p say "Where's the strike element?" or, "Where's Sabre 41?"  
 e And you don't want to have to look in the cockpit.  
 p Maybe even something else I might ask is, I might say:  
 o Tell me when Sabre three's at fourteen miles.  
 o Tell me when Sabre three's at point two.  
 e OK, yeah, that's what we need to hear. That's really  
 e good. Well, we'll say that it did tell you exactly what you  
 e wanted to hear, even though we didn't do it that way.

s 1.3.2  
 e So this point in the mission, you're approaching rendezvous,  
 e when your aircraft receives a data-link message about the  
 e threats downstream, and it looks like this:  
 v Threat data.  
 e You got a pop-up threat, SA-10, off the nose at 20 miles.  
 p Why does it say "Threat data?"  
 e When it says "Threat data," that means it has more  
 e information; but if it gives it to you all at once, you may  
 e miss something, so it's saying "Threat data" and waiting for  
 e you to say something like....  
 p "Threat data" may be a little long if somebody else is  
 p talking on the radio. If I'm talking to my wingman, I may  
 p not hear "Threat data."  
 e Well, if you're talking, then it won't talk at all; it'll  
 e wait for you, unless it's a high priority message, then  
 e it'll interrupt.  
 p OK, well, that may not be too bad, then.  
 e That's assuming a perfect system.  
 p That's a good point? OK, so where are we in this thing now?  
 p (Reading from the scenario script)...report:: data-link

p received...specifically, a new ground-to-air threat twenty  
 p miles ahead on your flight path.... "Threat data" advises  
 p you of the threat.  
 e What are you thinking about? How does that affect the  
 e situation?  
 p Well, I've got a threat I've got to worry about. From the  
 p display, he's in front of me. So I want to know how I can  
 p get around it.  
 e OK, how would you ask your airplane?  
 c Display threat envelope.  
 e Alright, and let's say it does that for you.  
 p You want me to shoot it, though, right?  
 e No, no, not in this particular case.  
 c Display threat envelope.  
 e OK, and, then, let's say it draws a ring around there or  
 e something...well, let's see, how can we work this in?  
 e For 1.3.2, you're looking for more details on the threat,  
 e when you say "Display threat envelope." Is that a fair  
 e assumption?  
 p What I'm looking for is I want to know when I'm going to be  
 p in lethal range. What I have to do is get around it or  
 p eliminate the threat. Conflict is probably the same.  
 p Workload's good, usefulness is good.  
 v Tracking J band.  
 e OK, so now you know it's tracking you, J band.  
 e And we'll say that besides that being the track ring, that's  
 e also the envelope at that distance and your altitude.

s 1.4.1 and 1.4.3  
 e Now what would you like to do?  
 p I'd like to know when it's launched.  
 e OK, how would you ask for that?  
 p Hopefully, that would be an automatic.  
 e OK, but if it isn't.  
 p I would probably already have chaff and flares armed.  
 e That's using some defenses, of course.  
 p I would want to know status of chaff and flares.... But, I  
 p wouldn't have time to do that, I'd have to know that  
 p already. I wouldn't even have time to ask the guy that.  
 e That's actually what we're leading to, is to pull some words  
 e from you, like you were just saying, about the status of  
 e chaff and flares. How would you ask the machine?  
 p I'd say:  
 c Status.  
 p Which would be a display type of command. It's going to  
 p display, obviously, the status of something. And then maybe  
 p I'd say:  
 c ECM.  
 c Chaff.  
 c Flares.  
 p If it could do that, that would be good.  
 e OK, it will; I'll show you...shows you the status of the

e countermeasures equipment.  
p That's fine. But now I'm looking at my airplane, to see  
p this stuff.  
e Right.  
p Well, if it says "Threat SAM-10," I'm not going to be  
p looking inside. Hopefully, I'm not going to be looking down  
p in my airplane as this threat comes up.  
e I agree.  
p Hopefully, I'm going to be out there fighting it. So,  
p maybe, it would be better if I said:  
c Status chaff flares.  
p And it says "OK," or something... "Armed, ready, chaff  
p ready, flares ready, five flares, fifty chaff." And maybe  
p I'll say:  
o Status J band.  
p or  
c Jam J band.  
p or  
c Chaff J band.  
p You said this's going to cut chaff for me. I'd say:  
o Chaff J band, flares two salvo.  
p OK, and that way I can keep my head up. So, in this case,  
p I'd say:  
c Status, chaff flares.  
p And it would come back and say "Ready chaff, ready flares."  
p At which point, I could say:  
o Chaff and flares.  
e To dispense them?  
p Yes. What that would mean is one chaff and one flare.  
p If I said a preparatory command, like:  
o Chaff salvo, two seconds, five, five bursts.  
p to program my system. OK, then I'd say:  
c Chaff.  
p And it would come out in salvo, or whatever I said to  
p program it.  
e Good. What if you had the ability to say something like  
e "Take care of this SA-10," and it knew the right combination  
e to do it for you? Would that be pretty handy?  
p Then I'd say:  
c Take care of the SA-ten.  
e Say it just like that?  
p As long as we're talking futuristic stuff, let's automate.  
c SA-ten chaff now.  
p or  
o Fire.  
c Dispense.  
e OK, all those things.  
p That'd be good.  
e Boy, we got him sold already! And what you get when you say  
e that is:  
v ECM and chaff selected; threat no factor.  
e So it tells you that the threat is no longer a factor; it

e defeated it. The combination of pod and chaff took care of  
e the SA-10. Is that the sort of stuff you need to know?  
p Not completely. Why is it no factor?  
e Well, it stopped tracking you when you jammed it. So it  
e broke lock.  
p OK, I'd like it to, rather, say "Stop track."  
e Instead of "Threat no factor," you want to know why it is  
e no factor?  
p Did it blow up? I mean, why? It's not tracking me, so I  
p should hear "Track stopped," or something like that. "No  
p factor" doesn't tell me anything. Does that convince me?  
p Probably not.  
e OK, alright, when it came up, it told you it was tracking  
e J band. So when it goes down, you want to hear that it's  
e not tracking in any band. Good, that's the stuff we need!

s 1.5.2

e The threat is no longer tracking your flight. The ECM  
e worked. As you approach the rendezvous, a few seconds  
e later, you get the following notice:  
v Rendezvous data.  
e You get a cue from your machine saying it has data on the  
e rendezvous.  
p And I'd say:  
c Position Sabre three.  
p or  
c Position Sabre one four.  
p Whatever it is.  
e OK, for 1.5.2 you want position of Sabre flight. And you  
e get that picture. They're eight miles in trail, which is  
e the correct formation, we'll assume, for this particular  
e mission.  
p I'd like to hear: "Sabre 14, three miles, six o'clock."  
e OK, alright, we can't do that right now.  
p Actually, what I'd rather hear is, forget the "Sabre 14;"  
p if I say "Position Sabre 14," I'd like to hear "Three  
p o'clock, two miles." or "Six o'clock, three miles." or  
p "In position," if you know what that means. I don't want to  
p re-hear the name of the flight. I've already said that. I  
p just want to know where they are quickly. The other thing I  
p think you ought to have is an acknowledge. Either a switch,  
p or say something...maybe on the stick an acknowledge button.  
p I'd also want to have a "repeat" command.  
e Right, if you miss something, have it queue up somewhere.  
e And then you can say "What?" or "Say that again?"  
p "Repeat," and possibly either an acknowledge button or say  
p "Roger." And if I don't say that, to repeat automatically.  
p I may not hear it. I may, also, be doing something else,  
p where I'm not concentrating on it. Just because it says  
p something doesn't mean I'm comprehending it. You know, the  
p computer is not going to be a WSO. It's not going to be the  
p guy in the backseat who says, "Hey, you got a bogey on your

p left side, break left." He's got something at stake, too.  
p And he's going to say, "Break left, I told you!" And I may  
p not have heard him. Everything's working, but I may not  
p hear him because I'm boresighted on somebody else. So if I  
p don't acknowledge it by saying "Roger" or pushing a button  
p on the stick, then how does the machine know that it's not  
p about to get killed? I mean, there's no feedback. So I'd  
p like to have "Repeat", which means repeat the last phrase,  
p or "Roger", and that means I've got the message.  
e You want it to say "Roger?" Or do you want you to say  
e "Roger" to acknowledge?  
p If I say "Roger" or a command, that says "I've digested the  
p information, thank you."  
e OK.  
p So if I don't acknowledge the command or the information,  
p then it should give it back to me.  
e OK, after some time delay, or something?  
p After a certain time delay, because if it says, "Hey, you  
p got a bogey, right three o'clock, at two miles," that's  
p great; but if I've got a guy out here close, the WSO would  
p say "I don't care about the other guy in front of you, we're  
p going to die in a second!" How's the computer going to know  
p that I'm getting that message? Also, something else you  
p might want to think about: The next time, if I don't  
p acknowledge a call, increase the volume a little bit to get  
p my attention more.  
e Or change pitch, or frequency, or something.  
p ...The machine screaming at you.  
e OK, that's good stuff; that's the stuff we need to hear.

#### s 1.5.5

e Well, the rendezvous is now complete, and your flight's  
e escorting the attackers toward the FEBA. As you approach  
e within twenty-five miles, if you haven't done so already,  
e your system will cue you for a fence check, like this:  
v Consent for fence check.  
e And it awaits your consent to automatically accomplish all  
e the appropriate items. So, first of all, what are the  
e appropriate items that you would do for a fence check?  
e And then give a command for it to do it.  
p I'd say:  
c Accomplish.  
p That's all I need to do.  
e What would you like it to do for the fence check?  
p Well, I don't know, it would depend on the airplane.  
e What do you do now that you can talk about, considering this  
e is unclassified.  
p I'd just like to make sure my weapons systems were armed, my  
p ECM's armed, I'm ready to go into the combat area. And I  
p don't want it to check my gas, I do that myself. But since  
p we're here, I'd like you to tell me fuels at certain times,  
p certain waypoints, whatever.

e Well, you say you're going to check your fuel yourself...  
p I can sit there and look at the fuel gauge faster than he  
p can tell me....  
e You may not have a fuel gauge.  
p Well, then, I need one, because, see, in the amount of  
p time.... Some things are not as good on voice, I think.  
p If I can sit down and real quick, say, "I wonder what my gas  
p is." By the time I said "I wonder what my gas is..." And  
p he came back and said, "You got 2.5." I could sit there and  
p go... And it's done.  
e Sure.  
p For purposes of the tape, I can take my eyes, focus, and  
p look back, and the information has been digested. Analog  
p bars are better than digital. Everybody says digital is  
p great, but analog bars, don't have to focus my eyes. Now  
p the gas gauge, with the tape in the F-4, I don't have to  
p focus my eyes. I look, and I know if the tape's over there,  
p I've got so much gas, and I can look back instantly.  
e We'll have a display like that a little bit later; tell us  
e what you think about it. So you told it to "Accomplish,"  
e and it says:  
v Fence check complete.  
e So it means it did all the things you wanted it to do, that  
e you preprogrammed on the ground or wherever.

s 1.6.1 and 1.6.3  
e So now you're initiating transition to low level operations,  
e planned for five hundred knots and two hundred feet. This  
e particular aircraft you're flying has full terrain following  
e capability. All you have to do is select values, modes, and  
e check equipment status.  
p Is this going to fly autopilot for me?  
e If you want it to.  
p OK.  
e It's up to you. What do you like to see before you go low  
e level? What are you looking for? What are your intentions  
e at this point, prior to going low level?  
p I'd like to have this display. If that's the formation  
p we're running, I'm going to have that display, because I'm  
p not going to be able to see them off my wing. And that  
p display is the horizontal situation.  
e Right, anything else?  
p No.  
e ...Make sure your TF system is working for you?  
p If I'm flying myself, I've got my hands on the controls and  
p I'm physically flying it.  
e OK.  
p This would be different to take control in a situation where  
p I had to react. It'd be quicker to be able to react to  
p something if I'm already flying, rather than get on the  
p controls, because now I don't have the feel of the airplane,  
p because I'm just riding....

e I agree. That's one of the hazards to an autopilot. Takes  
e you a few seconds to adjust. But, before going low level,  
e you want to make sure that your low level radar is working  
e right, I would assume, otherwise, you might hit the ground.  
e Is that a fair assessment?  
p OK, we'll assume that we're going to have a radar that's  
p emitting on our airplane, is that correct?  
e Yeah, it has full TF capabilities.  
p Well, maybe you'd want to turn that off, for detection.  
e It's a low probability of intercept kind of radar; it's very  
e passive. It's a futuristic airplane.  
p It's a passive radar?  
e It's relatively passive, so you can trust it. Well, if  
e you're in the weather at two hundred feet, you're going to  
e have to, right? And to get this mission done, you can't fly  
e high level, because the bad guys will get you.  
p Oh, we're in the weather now?  
e That's right, you're still in the weather, descending to....  
p Oh, then I'm going to have to have some kind of radar, then.  
p I'm not VFR.  
e Right, how would you select that, or how would you check it  
e and select it, this TF radar, TF equipment?  
p Hopefully, I would have checked it already. It would  
p already be checked, in the standby position. And I'd say:  
c Radar on.  
e OK, that's for 1.6.1 and 1.6.3.  
e If you were going to check the equipment using voice....  
e You said you hopefully already checked it, how did you do  
e that by voice.  
p I'd say:  
c Check the radar.  
e That's what you get. It's OK, it's in the green.  
e LPI, low probability of intercept, when it goes short bursts  
e so you don't get detected. Set clearance plane two hundred  
e feet, low altitude warning of one hundred feet. And you  
e have the option of selecting manual or auto. Manual where  
e you fly, and auto where it's hooked up to the autopilot.  
e We already talked about which one you would pick, and why.  
p I'd pick manual.  
e OK, how would you say that?  
c Manual.  
e And what you get is:  
v Auto.  
p I get auto?  
e Well, we assumed you're still in the weather.

s 2.1.2  
e So low level transition's been completed, and you're  
e proceeding at two hundred feet AGL on course. Current  
e threats are on the HSD, which you said you wanted to look  
e at. You probably wanted that there all the time, actually.  
e And you see AAA, SAM-6's, but none of them are currently

e tracking you, and they're far enough from your course, since  
e you're down at two hundred feet. But they're not a factor.  
e A few seconds later, as you're flying along, you get the  
e following:  
v Threat data.  
e You get a pop-up threat. The triangle means it's an  
e aircraft of some sort, and your system cues you that it has  
e information on the threat. So what are you thinking about  
e now?  
p I'm thinking about whether or not the threat sees me.  
e Okay, how would you get that information, using voice as  
e opposed to any other system?  
p I'd say:  
c Does the threat see me?  
e So you're looking for detailed information on the threat,  
e basically?  
p All I care about, really, since I'm leading a group of  
p bombers to a target, I'm only going to have to engage a  
p threat that is going to break up that mission. I'm not  
p going to just go attack somebody to attack somebody. So if  
p the threat doesn't see me, I'll say "Bye bye."  
e So you don't care what it is, at this point, then?  
p Exactly.  
e You just want to know if it sees you.  
p That's my main concern at this point.  
e And the message back from your airplane is, "Yes, it sees  
e you."  
p Okay.  
e What does that do for you?  
p It tells me I may have to destroy it, then. I want to know  
p what it is, what the threat is.  
e Okay, how would you ask for that?  
c What's the threat?  
v Helicopter eighteen miles, 12 o'clock low, closing.

s 2.1.4  
e How's that change the situation? I should add that, from  
e your intel briefing before takeoff, you know that the  
e Soviets now have a new kind of helicopter. It's their  
e equivalent of Blue Thunder. Has air-to-air missiles, it's  
e real bad.  
p Still slow, right?  
e Very slow, sure.  
p Next thing I'd say is:  
o Display lethal radius....  
o Display all lethal radiuses.  
e Okay, and it does that. Draws little rings around it.  
p And I'd fly my stuff between it.  
e Okay, would you want some computer help to fly between those  
e things, like to draw a path for you?  
p No, if I have where I need to stay out of, then that's a lot  
p easier. I'd just as soon it display the lethal envelopes.



e As you start to maneuver, to go between the threat rings,  
e the chopper is maneuvering and closing in on you.  
p We're going to engage him is what you're saying.  
e Yeah, that's what I'm saying, but I don't want to bias you  
e too much. I want to find out what the information does for  
e you. It's maneuvering, and it's closing in on you, so that  
e if you try to go this way, it's going to close the gap.  
p It's going to close the gap, or it starts closing the gap.  
p At some point, I would like to determine I'm committed.  
e How are you going to know that?  
p By my mind says "I'm not going to hack it."  
e But how are you going to know that by the information you're  
e getting in the airplane.  
p I'm going to know that before the computer will.  
e How?  
p Because since it's displaying its threats, I'll see the  
p trends, and I know what I'm going to do or what my options  
p are, the computer doesn't.  
e Okay, what trend are you looking for? Are you looking for  
e those threat rings to close in on where you're planning on  
e going?  
p Well, see, I'm looking for my flight path, what all my  
p options are, whether or not I want to get close to this  
p guy or close to this guy or close to this guy, and where  
p the chopper's going to go. And at some point in there, I'm  
p going to determine whether or not I have to engage him or  
p I'm going to try to avoid him. And that's depending on what  
p he's going to do and how he's going to react.  
e Well, let's say, for the sake of argument, that everytime  
e you make a turn to get away from him, he closes in. So it  
e looks like, if he isn't trouble for you, he might get the  
e trailing guys, the attack flight. That's realistic, I hope.  
p So I'll make the decision I'm going to engage. I'm going to  
p engage; I'm not going to tell the computer that, though.  
p I'm just going to know it in my own mind. What I'm going to  
p do is say:  
c Arm them up.  
v Master arm on.  
p I don't care about that.  
e Right.  
p All I care about is "Ready."  
e Okay, yeah, we've heard that a lot. "Master arm on" gets  
e real old, sorry about that. You want to know which missiles  
e are ready, too, probably, that it selected the long AIM, or  
e something like that, or you just want it ready when you say  
e "Arm them up." Do you want to know which missile it  
e selected, based on what it knows about the threat, or do you  
e want to tell it what missile, or...  
p I'd like to be able to have everything armed. And, ideally,  
p I'll select the missile that I'm going to shoot, or the gun  
p I'm going to shoot. And I'll select that via a switch.  
e Okay, if you could do it by voice, how would you do it?

p I couldn't do it by voice because it's a lot quicker to go  
p click-click-click.  
e Is it?  
p Yes, let's say I say:  
o Master arm.  
p To go master arm, I have to take my eyes off, I have to look  
p down, and flick a switch. If all I have to say is "arm em  
p up..."  
e That saved you some...  
p Then it arms them up, okay. Now, if I said there "Radar  
p missile." Radar missile electrons, electrons, electrons....  
p You know, a millionth of a second later they're armed up.  
p "Radar missile", it takes more time to say than to go click  
p onto my stick. So I'd rather that be a switch -- a three or  
p four position switch, to go forward for the guns, right for  
p the sparrow, left for the sidewinder, maybe back for the  
p shrike.  
e Okay, let's suppose that your airplane knows what the threat  
e is out there, it's a chopper, and it knows its distance and  
e its capabilities. So if you say "Arm them up," it might  
e even know what the best missile is to defeat that chopper,  
e to shoot it down. Think that's realistic, or do you still  
e want the option?  
p I'd like the option. The capability might be nice to say  
p "shoot the helo." And then pull the trigger. And have the  
p right thing come off the rail. However, what it doesn't  
p take into account is...well, maybe that helo that showed up  
p is something that's popped up, and I'd planned for different  
p threats, and I'd like to shoot it with something else and  
p save other missiles for later. So if I just say "shoot the  
p helo," and it uses all these missiles, since I have a  
p limited number of missiles....What happens when I get to  
p these other threats and I don't have one? You see, I may  
p not have to shoot the helo down. I may just have to make it  
p veer its course so we can go screaming by. Maybe I'd shoot  
p a guided rocket at it, or use a gun or something. Maybe I  
p don't want to shoot it down. I just have to eliminate the  
p threat so that we can accomplish our mission; I don't have  
p to shoot it down.  
e I agree.  
p So that's why I say I'd like to be able to make my own  
p decision. However, it'll be nice to have the capability, to  
p be able to say:  
o Shoot the helo.  
p Squeeze the trigger, and, boom, it's off.  
e Given everything's perfect, right?  
o Arm them up.  
o Shoot the helo.  
p Squeeze the trigger, because maybe I don't have time to  
p think about it. Maybe it's happening too quickly. So it'd  
p be nice to have that capability.  
e If it's a short range pop-up.

p But I would rather have the capability to say that, rather  
p than it automatically doing it. So if I said "shoot the  
p helo," he would automatically pick it; and boom, when I pull  
p the trigger a missile is coming off the airplane. But I  
p would probably operate, if I could, by selecting my own  
p weapon, and be able to do it that way.  
e That's good to hear.  
o Shoot the helo with the AIM-7.  
o Shoot the helo with the with the AIM-12.  
e Yeah, whatever generation, AIM-43 or something.  
p That may also be a possibility. So that way, it  
p automatically locks the radar, if it has a radar; it  
p automatically locks the heater, or slews the gun or  
p whatever.  
o Shoot the helo with a gun.

s 2.1.6  
e Okay, good, going along in that vein, you selected the  
e missile and you were just talking now about the other things  
e you have to do, about slewing, or the radar lock.  
e How would you tell your airplane to do that?  
p Okay, I'd say:  
c Lock threat one.  
o Threat two lock.  
p Yeah, but see, there may be four or five threats.  
e That's true.  
p Which one are you going to lock? I may not want to lock the  
p highest threat at that time.  
e Yeah, we'll get into that as well, a little bit later.  
e And what you get is:  
v Radar locked, in range, optimum five seconds.  
e Four, three, two, one. Pull the trigger, and blow the  
e helicopter away. And we have a picture of that, just to  
e plug for the artist there. See the missile going into the  
e helicopter, and it goes down in flames into the lake. Not  
e bad for a day's work; but, you're not done yet.

s 2.2.2  
e So the helicopter goes down in flames, and you proceed on  
e course to the mountain valley, approaching the lake there.  
e Your formation's still intact, but you realize that the bad  
e guys probably know you're here; and, as a result, on your  
e HSD:  
v Threat data.  
e You notice that the new thing there is the "18."  
p How do I know that's the new thing?  
e Well, because that display was continuously updating while  
e we were doing all those other things.  
p What if I haven't looked at it? It may say "Threat data..."  
e Okay, so you'd like that highlighted or flashing or  
e something like that?  
p Well, it goes back to the communication. Now you're talking

p communicationally, how does it know I'm accepting what it's  
p telling me? I may have a guy back here that's out of  
p position, and I may be telling him on the radio, "Hey, get  
p back in position." It comes up and says "Threat data" and  
p displays this thing. Well, that's fine; but I may not look  
p at it.  
e That's valid, sure. That's important.  
p Maybe I need to acknowledge.  
e Okay, so you'd would want to say something like "Roger."  
e Well, when it says "Threat data," it's looking for a reply  
e anyway, because it has more information. And it just gives  
e you the "Threat data" and waits for you to ask it for more  
e info. So how would you get that information, and what would  
e you be looking for, on a SAM-18?  
p I don't know.  
e That's our futuristic SAM.  
c What is it?  
e It's a bad SAM.  
c Am I in trouble?  
e All that, okay. And what you get...  
o Do I need to make out my will?  
e Not yet, we're going to save you. It's too early yet.  
v ECM ineffective, reroute available.  
e Okay, so it tried to jam....  
p I'd say:  
o Repeat.  
p Because I didn't hear it.  
e Okay.  
v ECM ineffective, reroute available.

s 2.2.4  
p I'd still just say:  
o Display the threat zone.  
e Okay, and it draws a ring that...  
p I do my own maneuvering.  
e Okay, you do maneuvering.  
p I do my own route.  
e Okay, so you wouldn't want any sort of command steering or  
e display or....  
p Only thing I'd like to know is my original route so I could  
p know how I'm doing.  
e Your original route always takes you up to the top, so that  
e swivels.  
p Yes, so if I went to the left, then it would be displayed  
p over here somewhere.  
e Right.  
c Display new routing.  
p I mean, I'm not going to look at this thing. You know, I'm  
p going to do my own route, I'm going to be looking out. Even  
p if I'm in the weather, I'm going to be getting my position.  
p I know where I am. I wouldn't want, unless I asked for it,  
p a new route.

e Well, it didn't give it to you; it said "Reroute available."  
e If you don't ask for it, it'll chuck it.  
p I know, but I wouldn't even want him to say that. That  
p would be an assumption that I could make. I mean, that's  
p just garbaging me up with more information that I don't  
p need. I don't need that.  
e Okay.  
p I know that if the computer's smart, it can reroute me.  
e Okay, and you know that if it can't jam it, that you're  
e going to have to go around it, or shoot it or something, to  
e defeat it. Okay, that's the stuff we need to hear. You  
e said you were going to fly your own reroute to go around  
e that...  
p Again, what I want to know is the threat zones.  
o Display threat zones.  
e We don't do that, unfortunately, but....  
p I know. That's what I'd say, but you should draw rings.  
p And that's what I would expect when it says "Threat data."  
p When it says "Threat data," that's what I'd like to know.  
p I'd like to see that automatically, without even asking.  
e So you'd know how close you are to being in danger.  
p That way, I can just fly around it. I don't need a computer  
p to tell me where to go. If I have a horizontal situation  
p display, I can sit there and plan my own route faster than  
p it can compute it, probably. I mean, if it just displays me  
p the horizontal situation, I can see that I'll need to go  
p there and there. Faster than it can probably even do it  
p with its electrons, because I can tell you where I'm....  
p Here's my target, here I am, I'm going to have to go like  
p that real quick, and it doesn't need to go bzz-bzz-bzz-bzz  
p and then come up with something that I have to look at and  
p say, "Well, I wonder why he's taking me right." I'll make  
p my own mind up for that.  
e Okay, we might have a suggested reroute that you could  
e either do or not do.  
p But, still, I'm not going to analyze the data. If I don't  
p want it, I'm not going to want it displayed.  
e We won't do it, then, you convinced me.  
p You know, why do I need that stuff?  
e I think that'd be really useful because that's one more  
e thing helping me stay alive. And I can do it or not do it.  
e That's my decision as the pilot. But, you know, it doesn't  
e cost anything to ask.  
p It'd be good to have if I wanted it. If I wanted it, fine,  
p that's great.  
e How would you ask for it, if you wanted it?  
c Display routing.  
e We understand that you don't want it.  
p If I wanted it, it would be nice to have the capability to  
p say:  
o I'm lost.  
o Where am I?

e Yeah.  
o Which way to the target?  
o Where's my wingman?  
e We'll try to cover all those things.  
p That's what would be nice, but I don't want anything that I  
p don't want, because if it's displaying all these buzzers and  
p bells and pinball machine stuff, it's just distracting me.  
e Your opinion is real important to us; that's why we're here.  
p I don't want anything on that scope that I don't want.  
e Right, but you want exactly what you do want.  
p Or as close as I can.  
e Nothing more, nothing less. So that's why we're out here,  
e trying to understand that. We want to know what you guys  
e want and what you don't want, and why, so we can make  
e smarter computers that'll really help pilots. A lot of the  
e things you said are fairly common. Some guys want the  
e reroute and some guys say, "Bullshit, I'll do it myself."  
e So we're hearing both.  
p It would be nice to have it. The one thing you're not going  
p to be able to do on this, that I can see, unless you do it  
p with holography, is a three-dimensional depiction of the  
p threats.  
e That's coming.  
p Because the threat is, you know.... Where am I going? Well,  
p maybe I can go under here, through a hole here....  
e There's a guy at Wright-Patt working on that: Three dimen-  
e sional holography for cockpit displays believe it or not.  
p If you can do that, that might be fine. Now you're talking  
p saturation level; the "keep it simple" principle abounds.  
e Yeah, that's hard to do. Getting back to the scenario, it  
e gives you the following: Shows you the old route, which it  
e should have had up there all along. And it shows you the  
e new reroute to the right and an acceleration to meet your  
e TOT. So is that the sort of information you need?  
p I don't know if it'd be time critical or not. If it is time  
p critical, then what I would like, if I planned my own route,  
p I would like to push it up to, whatever. I'm not sure  
p exactly how I'd word this, but I'd like to know what it's  
p going to take to get me there, giving current maneuvering.  
p But I'd want to get back on my route as soon as I can. This  
p is going to be my game plan: to get back on my route, so  
p what I'd do is, myself, fly to get back on my route. So one  
p of the things I'd like to know is how I'm doing once I get  
p off my planned route.  
o How goes it?  
o How's it going?  
p A reply might be "You're behind by this much."  
e Isn't that what waypoints are for, to check?  
p Yeah, but it's done manually.  
e Right.  
p I mean, I do the same thing. I say, "Hey, WSO, how's it  
p going? And he goes, "Wait a second," figures it up, and

p says "We're down fifty pounds in fuel and behind a minute,"  
p something like that, especially on low level missions. A  
p follow-on question may be:  
o What do I need to do to make it up?  
e Alright, that's valuable stuff, once again.  
p That's a little bit harder, because now you're talking  
p variables, because it doesn't know the route that I'm going  
p to fly.  
e Yep, so it can only project a bit.  
p And I'd like to say:  
o Status check point to position now.  
p And it'd give me the time to get there if I flew direct.  
p And whether or not I'm behind or not.  
o Status time.  
p And then I could adjust my airspeed accordingly to get  
p there on time.  
e Alright, good.

s 2.2.6

e Given that you're adjusting your course and that you as  
e flight lead are the only one, so far, that knows where  
e you're going -- everyone else in the formation has the  
e information about the SAM-18; and everyone else has probably  
e tried to jam it, and been unsuccessful -- but they don't  
e know whether you're going to go right, left, or...  
p Who doesn't know?  
e The rest of the formation. They don't know yet, right?  
p "Two. Bingo. Mayday." is all they have to know. They don't  
p need to know I'm changing route. They're following me,  
p right? They've got a horizontal situation depiction also.  
p They're going to know where they are. They're going to know  
p what they're doing.  
e Do you want them to follow you? What if they think it'd be  
e better to go left?  
p I may say "Split." I'll tell them what to do, otherwise.  
p Based on the tactics you guys are flying here, they're going  
p to follow. That's a reasonable assumption, I think.  
e I think it would be, too, especially since you have data-  
e link between airplanes. If they know your position, you're  
e going to know their position.  
p And that'd be displayed all the time. And since they're  
p displayed, I'm going to be able to instantly look down and  
p see them, and see if they're following me or not. If  
p they're not, I'm going to say, "Hey, come on back. How about  
p getting in trail with me? Step it up, beat it up, close it."  
p But I'm going to say that over the radio, it's going to be  
p from me to him, pilot to pilot. As I see it, the horizontal  
p situation display would be almost like a primary instrument,  
p because that way I can look down instantly and without even  
p focusing my eyes...if the characters are made in such a way  
p that I can just glance at it on a normal scan, I just know  
p where they are: He's here, he's there, I got a threat here,

p I got a threat there. And I don't have to read it because  
p reading I have to decode.  
e If you can glance and see that the green guys are where  
e they're supposed to be, then that's real valuable.  
p That's what I see. Okay, next question, let's press.  
e So, anyway, we'll say you passed it to the wingman.  
v Message sent.  
e And it comes back and says "Message sent," which means the  
e message was sent and acknowledged.

s 3.1.2

e Okay, so now you're proceeding on the rerouted segment of  
e your low level approach at two hundred feet AGL when your  
e aircraft reports from a JTIDS update that a new air threat  
e now exists. You have requested additional threat  
e information, so the horizontal situation display has  
e automatically changed scale and the threat are ID'd with  
e location, direction, speed, and altitude. Like that, that's  
e what it looks like. Now they're in yellow because they're  
e still unidentified.

p Why is the ground threat not displayed, still?

e These are not optimized displays.

p Well, I was just wondering, because the ground threats, they  
p all disappeared.

e This is a couple of minutes later, after you did the  
e rerouting and you're beyond the threat, and now you've got  
e a possible air-to-air threat.

p Okay.

e Your aircraft is still in the air-to-ground mode in terms of  
e looking at ground threats. You know, the sensors are  
e focused low as opposed to high, or something like that. How  
e would you reconfigure your sensors?

p I'd probably keep it the way it is, because if I'm getting  
p this information without the radar looking at them, then why  
p do I need the radar to look at them?

e Okay.

p Obviously, I don't.

e What if you have other sensors, though, that are passive.  
e That could give you more information and possibly ID those  
e guys....

p Well, hopefully, if they're passive, then they'd be on all  
p the time, and when they get something, then they'd display.  
e You'd like, like a cue, like "Infrared display ready," or  
e something like that, or do you just want it to pop up?

p Well, I don't want it to eliminate anything. What I'd like  
p it to do is to display itself without interrupting my train  
p of thought. In other words, to show up on the periphery,  
p and then if I want to dial it up, fine.

e If you were to reconfigure for an air-to-air mode from an  
e air-to-ground mode, how might you say that? This is a bit  
e unrealistic in here, but bear with us.

c Switch air-to-air.



e And it comes back and says:  
v Configured air-to-air.  
p I don't need that. I'd rather have him not say that. I'd  
p rather have a visual in my sight, or my helmet, or on the  
p canopy. You know, if you're talking optimized cockpit,  
p maybe I'll say "Display air-to-air," and there'll be a light  
p source in the canopy where they are.  
e Great, that's the stuff we need.  
p And then again, what I'd like to have is an acknowledgement  
p signal. What if I don't digest that information.  
e So you'd want to be able to say "Roger," or "Okay."  
p You know, you can talk about artificial intelligence, but  
p that's where the human...you know, I'm used to flying with a  
p WSO. He can sit there and think, "Well, he probably doesn't  
p see that. He probably doesn't know what I'm saying." So  
p he'll maybe say "Did you understand that? You need to do  
p this, you need to do that."  
e Good stuff.  
p And the computer, it's going to be hard for a computer to  
p understand that I may come back and say, "Yeah, I know what  
p I'm doing." Or, "Hey, I'm going to do this." But it's  
p going to be hard. As I see it, the biggest problem with  
p this is that the computer won't know that I got the  
p information. So you're going to have to have some type of  
p an acknowledgement.  
e Well, but, wait a minute, that's a problem now. You can  
e look at your engine instruments; but if you don't look at  
e them, you don't have the information that you just got an  
e overheat.  
p But they're always displayed.

s 3.1.4  
e The other thing that we're going to ask you to do is get  
e missiles ready again, just in case these guys turn out to be  
e a real problem.  
p Hopefully, they'd be up already.  
c Arm them up.

s 3.1.6  
e Then we're going to move on to some futuristic stuff that I  
e was talking about before. We have an infrared sensor on  
e this airplane, that's a passive sensor, and if for some  
e reason the machine wasn't smart enough to have that working  
e all the time...if you had to specifically select it, how  
e would you do that?  
p What do you want me to select?  
e It's the infrared search and track sensor.  
p I'd just say:  
c Heat  
p or  
c Heater on.  
e Okay, great.

p Or something, some code word.  
 c Heater.  
 p Infrared's too long, it's too hard to say.  
 e I agree, I agree. Yeah, IR, heater, or something short and  
 e sweet.  
 c IR on.  
 c Heater on.  
 e And what you get is: There's your IR. Shows them out about  
 e two hundred miles, twenty degrees left.  
 p What I'd like to say is:  
 o Status.  
 p And I'd like him to say "20 left, 200 miles." I'd like to  
 p also have this display, so I can actually look at him, but,  
 p again, if I'm looking over my shoulder.... Most of my time  
 p is going to be looking back, because I don't trust any of  
 p this stuff. I'd like to be able to say:  
 o Where is he?  
 o Bogey dope.  
 e Good.  
 o What's he doing?  
 o Is he pointed at me?  
 p That tells me he's a threat. I don't care about him if he's  
 p going away. You know, that's what I want to see.  
 e Well, it wouldn't have identified it as a threat unless it  
 e looked like it was coming at you.  
 p The thing with the arrows on it is great.  
 e Okay.  
 p I'd like to have this selectable. But I should also have  
 p that horizontal depiction.  
 e Yeah, one shouldn't wipe out the other. I agree, and in a  
 e real airplane, it wouldn't.  
 p Maybe I'd want to say:  
 o A window at thirty left.  
 p And I'd want to see everything within that specific size  
 p window at thirty left. And it'll say "Nothing," "Clear."  
 p Or it may say "Contacts twenty miles, twenty-seven left."  
 p The good thing about this, if this can happen, is that way,  
 p since it's a single seater, I can sit there and look around.  
 p I can look for guys on the ground; but if they're shooting  
 p at me, then I can maneuver too. And I still have that  
 p horizontal display, but I can say:  
 o Where's my wingman?  
 o Where's the strikers?  
 e And have it talk back to you while you're looking.  
 p And have it talk back to me in a horizontal position, so I  
 p don't have to sit there and look in the cockpit. These  
 p things are great, but the HUD's no different than a cockpit,  
 p I still have to look there.  
 e It's a step in the right direction, but, it'd be nice to  
 e have a wide field of view HUD, too, that was wrapped all the  
 e way around, or helmet mounted display where you had that  
 e information that you needed.

p I might want to say:  
o Airborne status.  
p That would give me threat...  
o Airborne threat.  
p "None." And the airborne status may be within a certain  
p range. I may say:  
o Airborne status within ten.  
o Airborne status forward half.  
o Airborne status forward quarter.  
p Something I'm going to use, because I'm not going to sit  
p there and look in the cockpit. I'm going to look in the  
p cockpit as little as possible.  
e I agree.  
p If you want to get somebody to run those computer system  
p push buttons, then put another guy in the airplane. But as  
p a pilot, I'm going to be looking out. I want to look at the  
p ground, look at the clouds. Try to hide myself, get as low  
p as I can. Jink and weave and pull some G's, to defeat a  
p threat. Ideally, if I'm flying around, I'm not going to fly  
p it straight and level at two hundred feet, if I don't want  
p to be a sitting duck. Too predictable. You know, I'm just  
p droning along, and no ECM system in the world is going to  
p help me.  
e Nope, that's true.  
p So I need to look out. As a fighter pilot, I need to look  
p out. That's where my eyes should be, is outside of the  
p airplane, not in some magic system inside.  
e I agree. It's important, probably, to have both, though.  
e So you can glance inside.  
p Yes, I need both, because I need to update my situation.  
p I can only look outside for so long before I say, "Well,  
p where am I?" I have to know where I am all the time. The  
p computer is just a backup. The thing about the voice is  
p it's nice. It would be nice to be able to say:  
o Where's the bogey?  
p And I think the window call, maybe, is good. Tells you  
p what's out there. We're talking air-to-air threats now,  
p so draw a little box, a window at thirty left, and say  
p "There they are." Or, "Hey, I've got two contacts, forty  
p miles." And that would be good when you start talking  
p multiple bogeys. I may say "Air-to-air status." "Bogey  
p status within ten," and that'll give me everybody within ten  
p miles.  
e Okay, great.  
p But that is not quicker than looking down at a radar, a  
p horizontal display. If the same stuff was on the horizontal  
p display, I could get all that information quicker because  
p I have the range rings. So in that case, the voice stuff  
p probably wouldn't be good unless I wanted to know where a  
p specific guy was.

s 3.2.1  
e So you called up this IR sensor; and it's been watching for  
e a while and it can determine from their heat signature what,  
e possibly, these airplanes might be.  
p That's the sort of information that would be fairly  
p valuable, and that's probably something I'd want  
p automatically, as soon as it knew whether they were good  
p guys or bad guys, I'd want to know that right away.  
e But if you had to ask for some sort of identification,  
e friend or foe on these guys, how might you do that?  
c Friend or foe.  
e You're not supposed to use my words.  
c Hostile?  
p Yes or no. I might say "hostile," and it comes back and  
p says "Friendly" or "Hostile."  
v Hostile.  
e Turns out they are hostile after observing them.  
p And they're red, that's a good idea.  
e Hey, alright! That's one good idea; write that down!  
p Actually, I think you guys have some good ideas. I'm just  
p trying to get you oriented to the right direction.  
e Good, good, that's what we want. That's why we're here.

s 3.2.3  
e So, it also turns out that this infrared search and track  
e has a wide angle of view, and that it can window in on  
e certain segments of the sky and maybe get a closer look at  
e those guys. How would you ask for that?  
p Well, again, the first thing I want to know is, basically,  
p if they see me, if they're targeting me, if they're pointed  
p at me, and I would probably get that from the horizontal  
p display.  
e Right, it looks like they're pointed at you, but you don't  
e have any indication that they're tracking you, or that they  
e see you. I mean, just from their position and direction of  
e movement, you can tell they're headed toward your general  
e direction. But, if you could zoom in on those guys to get  
e an idea of their formation, how might you do that?  
p How would I do it?  
e Yeah, using the voice command.  
p I still don't understand what you want to do.  
e Okay, we want to look at them in more detail.  
e You've got several modes on this IR sensor. Suppose that  
e was a big dot and you couldn't see whether it was one or two  
e aircraft. Home in on that particular area of the sky.  
p If the machine is capable of zooming and knowing what it is,  
p then it should be able to display it right there. What can  
p I say here? I don't know, I don't really foresee....  
c Zoom.  
p I guess.  
e Great. That's what we need.  
p It's not telling me what to zoom at.

e Well, there's only one thing up there, so it'll know. If  
e there were a couple of things, maybe it'd number them. So  
e it could zoom on one, zoom on two, etc.  
p Yeah, but if I'm doing that, I'm going to have to have my  
p head down. It won't work. I want to just sit there and  
p glance at the thing and look out.  
e Well, you could glance in there when you heard the "Hostile"  
e and then you could look around, and you could say "Zoom."  
e And it'd zoom, and then you could look and see it at just a  
e quick glance.

s 3.2.5

e Okay, anyway, you get a zoom view, find out it's a formation  
e of four, for sure.

p It does me no good. It didn't help me at all. I could have  
p seen the same flight of four on the little thing.

e This is one of the dumbest displays we have in here, that's  
e for sure. But we left it in there so we could tell pilots  
e that these are dumb displays; and they/you can tell us how  
e to make them better. After looking at these bandits for a  
e period of time, it's able to do a track analysis....

p Okay, again, I'd like to know if they're emitting. It would  
p be nice to know if they're tracking me.

e Okay, they're not.

p It would be nice to know what type they are, with their  
p lethal zones displayed. Now all that could be displayed  
p better than voice, I think.

e I agree.

p A yellow and red zone or something. Once the red symbols  
p come on, you could also display, real quick, the lethal  
p zones. That way, when I start to maneuver I'll know if I'm  
p going into a lethal zone, and to where they're emitting.

p You can usually display the emitting on and off, and that  
p would be a constant display.

e Yeah, the threat display.

p And that's the horizontal, you know, that map view. Okay,  
p next question.

e The track analysis is what we're looking for specifically.

e This thing is able to do, based on past observation....

p A prediction?

e A prediction of where they're headed, how fast they're  
e going, that sort of thing. How would you call that up, if  
e you had to specifically ask for it?

p In this particular case, I'd probably say:

c Point of encounter.

e Good.

p And that would display it on the HSD.

e You're not going to get exactly that right now, but this is  
e what we have:

v In range for air-to-air radar.

e You get a little vector on them, and we'll say each of those  
e ticks represents a hundred knots of closing.

p That would be good because if I think he's going to be able  
p to see us, I may want to move my flight around him.  
e And you also heard a cue that they're now in range for air-  
e to-air radar.  
p For their radars?  
e No, for yours.  
p Okay.  
e They're in range for your radar is what that meant, as  
e opposed to you're in range for their radar.

s 3.2.7

p Now I need to do something?  
e Well, does that change anything? Having information that  
e they're in range for air-to-air radar? Would you like to  
e use that on them, or not?  
p No.  
e Tells them too much?  
p If I don't know where they are, yeah, I'm going to have to  
p do something. If I just know they're out there somewhere,  
p I'm going to have to try to find them. If I have good  
p enough information from the HSD via GCI data-link.... If the  
p GCI is so good that they can actually tell me via data-link  
p where they are in relation to my airplane, I don't want to  
p emit, because I don't want them to fire something at me. I  
p don't want to emit yet. I may not need to ever emit. You  
p know, if we're talking far enough into the future, with a  
p GCI and data-link working, I would never need my radar.  
e To tell them where you're at.  
p Until I'm going to fire something. At this point, I'll  
p assume that, since you want me to turn it on, I'd say:  
c Air-to-air radar on.  
e Yeah, I agree with you, I wouldn't want to do that either.  
e What I'd want to do, though, is keep tracking them; and as  
e soon as it knows what they are, tell me, so I know what  
e tactics I'm going to need.  
p Again, that goes to the communication thing. You're right.  
p How does the machine know if I want that ID or not? And how  
p does the machine know that I've digested it?  
e Well, I always want to know the ID. But whether I've  
e digested it, then that's something else. Anyway, what you  
e get is, you get them on a radar picture there.  
p No, I don't like it. It says "4 MIG 39." But I've got to  
p look in, and look at it, and read it to get the information.  
e I didn't think of that, that's a good point.  
p That "MIG 39" is useful, but I want to hear that, not read  
p it, or both, perhaps.  
o What are they?  
p Is what I'd say.  
p "Unknown" would be his answer. Or "MIG 39." Also, what  
p would be good is a symbol depicting type threats because  
p that way I can look at it and then glance away without  
p having to read it. It's fine, you know, when you have

p "MIG 39." I could sit there and glance and read that, but  
p when I've got twenty of these things on the scope and  
p they're all different.  
e All over the place...  
p Now, you know, I can't read them all....  
e You may have to memorize symbols, too, so what's the  
e difference? Sixteen different symbols versus.... We do have  
e JTIDS symbols....  
p It's easy to sit here and say, "Well, what are they?" You  
p know, I've only got the one threat; it's easy. When you  
p talk real world....  
e Sure, it's six different ones.  
p You got a lot more threats.  
e You bet. Again, that's good stuff to hear.  
p Which question we on?  
e 3.2.7 was the switching to the radar.

s 3.2.9  
e To continue on, here, your onboard air battle management  
e system has computed optimum intercept profiles for these  
e guys. These intercept options are available upon request.  
e You know that because you've been flying this "airplane" for  
e a while; so you know what it'll do for you. How might you  
e request these intercept options, verbally?  
p I don't understand. You mean, option one? Option two?  
p Stern?  
e Let's say, on the ground you programmed your desired tactics  
e and things that you like to do when you get in different  
e situations. You'd load it up in computer on the ground, and  
e now you'd like some options about which one is the best for  
e this particular situation, based upon all this sensor fusion  
e that the system's doing for you. In other words, the  
e computer knows where they are, and it can show you the  
e flight path that will get you to them for the proper....  
c Collision.  
p That's probably what I'd want to know is the quickest way to  
p get there.  
e Okay, "Collision." Great, and what you get are two options.  
e Option number one should have a "0.5 PK" by it. It's not on  
e the display, but it should be there. And option two should  
e have a "0.98 PK." Option one is quicker, obviously, and two  
e is more conservative, a stern conversion, but it has a  
e higher PK, 0.98. Is that information useful?  
p No.  
e Okay, what would you rather see, or not see?  
p I don't think I need it. I can do my own, especially if I  
p have this horizontal display, I can figure out my own  
p intercept. I view that as just clutter. I think that I can  
p just do my own if I have the horizontal display.  
e And you wouldn't even ask for that.  
p Then I can see how it's going; I don't need the computer to  
p tell me how it's going; I can see how it's going.

e Okay, alright. Given that we're talking to a lot of  
e experience levels, from second lieutenants up to one star  
e generals we've talked to already, the younger guys are  
e interested in help like this.  
p Well, like I said, it may be nice to have it available. And  
p it may work out when you have twenty threats out there.  
p That may be something useful, but for this particular  
p example, I would rather just have the horizontal display so  
p I know how my bombers are doing, because that's my mission  
p on this one.  
e Right.  
p I need to see how the bombers are doing. I need to keep  
p those guys away from my bombers. And where they are in  
p relation to the airfield. If I could throw them a head fake  
p that'll put them in ten-mile trail, I'm going to leave them  
p there. It doesn't bother me if they're in ten-mile trail.  
p If they are co-airspeed, they're not going to get me. My  
p mission is to get the bombers to the target. So I may not  
p have to engage them. Maybe my game plan will be to try to  
p fake them, and then just to leave.  
e Yeah, I'd be more interested in that, too, given the  
e mission.  
p But intercept options may be useful.  
e Well, we're trying to build a vocabulary, so we're going to  
e do this air-to-air engagement; we've already done air-to-  
e ground stuff.

s 3.2.11  
e And what we're looking for here, specifically, is: If you  
e had to pick one option that you wanted to fly, which one  
e would you pick and why, and how would you pick it verbally?  
c Option two.  
e Please rate that. What happens is one goes away and two  
e goes white, meaning it's programmed into the computer now.

s 3.2.13  
e And, again, like before, whenever you have options displayed  
e on your screen, you're the only one that has them. And when  
e you make the decision as flight lead, the other guys may  
e need to know what's going on. Or maybe they don't need to  
e know. Certainly your wingman would want to know what  
e tactics to use, I would think.  
c Info out.  
v Message sent.  
p I don't need that.  
e Okay, yeah, me neither...well, I don't know...I'd like to  
e know that he got it and understood, or acknowledged.  
p He can change it visually if he wants.  
e Okay.  
p But I don't need that over the radio. I can say, if I want  
p to know:  
o Confirm it.



p I can say:  
o Is message sent?  
p And it can say "Message sent." But I don't need that; I  
p don't need that acknowledgement. I can see it quicker than  
p he can say it. On an HSD, I can just take a quick look,  
p flash, and I can confirm that it was sent faster than he can  
p say it.

s 3.2.15  
e Well, on the next page, you're now committed against the  
e air-to-air threat, even if you didn't want to be.  
p We're committed. Roger, new mission.  
e But you're concerned about the attack flight, of course, and  
e request an update on their progress. And what you've  
e already expressed is that you'd like to see them all the  
e time on the HSD anyway.  
p Yeah, if you had that capability, that'd be great.  
e Yeah, well, I think that's probably within the realm of  
e possibilities anyway. But if you had to ask, specifically,  
e to get info on the attack flight, how might you do that?  
c Status of strikers.  
v IP inbound.  
e They're IP inbound.  
p That's fun. I might also say:  
o Time to target.  
e Okay, good. That's also for 3.2.15. And you want the  
e strikers time to target, obviously, as opposed to time to  
e target for you and your wingman.  
p Right.

s 3.3.1  
e Alright, you're assured that you're going to go after the  
e air threat and allow the attack flight to do their thing and  
e hit the airfield. With these intercept profiles, you can  
e get command steering on your HUD or a GCI-type vector. How  
e would you ask for that? I know you wouldn't, I wouldn't  
e either, but if you had to?  
p I wouldn't say "Give me a vector." There might be another  
p situation where I'd say "Give me a vector," like for an ILS  
p approach, or something...  
c Steer me.  
e Okay.  
p I, myself, would do my own intercept.  
e Yeah, me, too.  
p But this is an easy problem. The assumption, here, is I  
p have a flight of four, all staying together, coming at me,  
p and they're the only guys that are around. You know, Ray  
p Charles can probably do this one. If you're talking twenty  
p bogeys out there, feinting this way and that way, now you're  
p talking stuff that's hard. It's hard for anybody. So,  
p maybe vectors would be a good option.  
e Good.

p I'm not saying it's useless. In this particular case, I  
p wouldn't utilize it. You know, it'd be relatively simple  
p for my experience level, which isn't great. But with my  
p experience, it would be fairly simple. And with this HSD,  
p like I said, almost anybody could do it.  
v Vector 060.  
p OK.

s 3.3.3

e A few seconds go by, after following this vector. You're  
e halfway through your stern conversion. Now the enemy  
e formation's not maneuvering. It looks as though you've not  
e been detected yet. And, it says here, you're ready to split  
e your flight and assign targets. Are you ready to split your  
e flight and assign targets? Is this the right time to do  
e that?

p Go over the question again.

e Okay, you're closing in on them. And we're asserting that  
e you're ready to split your flight and assign targets. But  
e maybe you're not. What do you think? In other words, do  
e you want your wingman to go out to whatever tactical  
e formation and then pick...

p Well, I don't know. Now you're talking tactics. And, I  
p don't know the answer to that. The tactics in the situation  
p would dictate. I may split them, I may not. Maybe I want  
p to kill them all myself, you know, to up the kill count. I  
p don't know. Probably not, but I don't know the answer to  
p that question. I may deploy him, I may not, it would depend  
p on the situation. So, yeah, if I wanted to deploy him, I'd  
p tell my wingman to:

c Deploy.

p But I'd do that over the radio.

e That is going to be the most constant word in this  
e vocabulary: deploy. I don't think anybody has used anything  
e else.

c Split.

c Go.

c Get out of here.

c Go line abreast.

c Go pincer.

e OK, now we have some variety! And your airplane responds:

v Message sent.

e "Message sent," meaning that your wingman got the message to  
e deploy and acknowledged.

p Something I just thought about: When I talk on the radio,  
p how do I know that the radio is getting out?

e You get a reply, "Two."

p No, not necessarily.

e Well, you hear it, you hear yourself talking, but you also  
e know that two got it when he says "Two," or "Roger."

p But I also hear it going out. I was thinking I'd have to  
p use a preparatory command, rather than have the computer

p repeat it. If I said "Send," and then my message, I'd hear  
p it when it says it back. And that way I know automatically.  
p As I'm talking, I hear it, then I know it's going out, just  
p like a radio. At the same time I talk, I hear it. So if I  
p say "Send: deploy," the "Send" would say I'm going to send  
p the message "deploy." When I hear it at the exact same time  
p in my headset, I know that the message is sent.  
e So that while that's going out over data-link, you get a  
e little feedback in your headset that sounds like a radio  
e call, to give you a warm fuzzy that...  
p That the message was broadcast.  
e Okay, but you'd still want it acknowledged, then, right? So  
e you want him to say "Two," or something. So maybe instead  
e of "Message sent," you get "Two," or whatever he says in his  
e cockpit. "Roger" or "Wilco" or whatever.  
p Well, yeah, all the "Message sent" means is that it's  
p sending out. That's what I was talking about. I don't know  
p if he's picked it up or he's acknowledged it yet.  
e Yeah, except that based on your years of training on this  
e machine you know that "Message sent" means "sent and  
e acknowledged." But it doesn't want to say "Message sent and  
e acknowledged" because then it's too verbose.  
p It could do that with a tone. It can go "Beep."  
e A lot of guys have suggested that. It's a good idea; I  
e think that's the way to do it. A little beep, for yes, and  
e boop, if it didn't make it, or something. Oh, yeah, did you  
e check the boxes for sending the wingman out?  
p I think I've missed a few of these.

s 4.1.2  
e Okay, you're getting in close, about sixty miles.  
p Looks like I'm losing the fight.  
e No, not yet, you're doing great. They haven't seen you.  
p I'm still behind the three-nine line, but that's okay.  
e They haven't seen you yet, though, so you're okay. You got  
e good jamming on, so you're invisible, stealth. Okay, and  
e the next thing that happens is your airplane says:  
v Target assignment ready.  
e Which means that it's figured out who should go for what.  
e If you want to find that out, it has an opinion on who  
e should be your targets and who should be your wingman's  
e targets.  
p I'd say:  
c Go ahead.  
e So it circles your guys in blue, and circles the wingman's  
e guys in white. What do you think? Is that yea or nay?  
e Will you accept that assignment?  
p It would be easier if I was able to just touch the ones I  
p wanted. Those are mine.  
e Good.  
p Would it be easier if I touched them and then sent it to him  
p and said "Those are yours?" Yeah, then there's no mistake.

p Whereas now, with radio calls, you get all kinds of "who's  
p got what" problems. That would be very good, if I could  
p touch them and they displayed on his scope.  
e How do you ask for it?  
p You're doing just voice? If I was doing just voice, I'd  
p say, "Hey, Charlie, you got the left two." I'd have to tell  
p him over the radio if I could, or, I'd tell him directly.  
e Yeah, the other thing is if they're numbered 1,2,3,4 you can  
e say "I got 3,4. You got 1,2." Or you can say "You got  
e 1,2." And he knows by default that you have 3,4.

s 4.1.4  
e But, specifically, if you like that, you can say "OK" or  
e "No" or whatever words you find suitable.  
p I'd probably say, in reality:  
o I'm in on the left ones.  
p And then assume he's in on the right ones.  
e Okay, if your wingman's out to your left side, though, does  
e that affect....  
p It may or it may not. I may say "I'm on the right ones."  
o Check my six.  
p Or "I'm in on them all." It depends.  
e It'll vary, yeah.  
p But the computer, giving me an option, showing who should  
p take what, it's awful. It goes against the keep it simple  
p principle.  
e It might be a good crutch for some younger guys.  
p I have a theory that, as soon as you get in the airplane,  
p your IQ goes down about a hundred points. So you need to  
p keep everything very simple.  
e That's right, your attention is spread too thin.  
p Right, your memory goes, everything goes because there's so  
p much happening. Your normal functioning level....  
e You revert to instinct.  
p I see it all the time, especially here with students. I  
p know that I can explain something; and they'll say "Oh yeah,  
p I understand that, I understand that, I understand that."  
p But when you get out there, the....  
e Too much overload.  
p I don't know how to explain it, but it needs to be kept very  
p simple.  
e Yeah, I know what you mean. It's different when you talk  
e about it than when you actually do it.  
p The simpler the better.  
e Well, just to get some words out of you, though, given that  
e you like that assignment....  
c I like it.  
v Message sent.  
e We already know you don't like it; but that's what we get.  
p Well, "Message sent" is fine, if it's telling me that he  
p acknowledges.  
e Message acknowledged is implied.

p I can do the same thing by looking at it; but, again, it's  
p not bad. Maybe "Message sent" is not a good word. But the  
p voice is fine because I'm going to be looking out trying to  
p get a tallyho, and checking six because those guys aren't  
p on the screen.

s 5.1.2

e As your wingman moves out to line abreast, the enemy begins  
e to maneuver and appears to merge.

v Targets cross.

e As you close within thirty-five miles, the onboard systems  
e report a target split and display that on the HSD. Targets  
e numbered "1" there, the blue guys, appear to be going toward  
e your formation; and the targets numbered "2," the white  
e guys, appear to be separating and going toward the airfield  
e to go after the attack flight. What are you thinking about;  
e what are your concerns?

p I'd tell my wingman:

c You've got the ones.

c I've got the twos.

e Okay, great.

p But that's no different than normal, though. Only  
p difference is I've got this magic scope, like an F-18 radar  
p or whatever they have. I might say "I've got the guys  
p breaking off to the right; you take the ones on the left" or  
p something. So that's not a whole lot different.

e OK. The computer reassigns them and circles the other guys  
e splitting off in blue and....

p I'd probably tell them in this particular situation I'd say

p "Take the face shots and then come back right to such and  
p such a heading." In other words, I'm telling him to blow  
p through these guys. "If you can shoot them fine; but we  
p want to get back to the package. We've got a threat going  
p towards the strikers."

s 5.1.4

e So you swapped assignments, and you said that normally you'd  
e do that over the radio. So, obviously, you'd want two to  
e know about it.

p This displays target numbers of who's going to which  
p airplane, right?

e But, really, that shouldn't be numbered 1,1, 2,2. It should  
e be 1,2,3,4 so you can distinguish them individually, in case  
e they do other maneuvering. And then, of course, you pass  
e the information on the radio to two, but how would you do it  
e via data-link?

c Switch targets.

v Message sent.

s 5.2.2

e Next thing, a few seconds later, no:

v Targets in range in ten miles.

e Your targets.  
c Arm them up.  
v Master arm on, radar locked, in range, optimum five seconds.  
e So it's giving you a shoot cue: 4, 3, 2, 1, squeeze. You  
e get two missiles off.  
p What I would rather have is "Optimum" or "Shoot." Because  
p what happens is it's optimum in five seconds. But if they  
p do a maneuver or select afterburner, they could go out of  
p the envelope. I'd like an "In range" and "Shoot," or  
p "Optimum shoot" call. It'll be good to have it over the  
p audio because I don't want to be looking in the cockpit to  
p do this.  
e That's exactly the wrong place to be looking then.  
p So that's great if it can come back and say.... I'd say:  
c Is he locked?  
c Locked?  
c Am I in range?  
p "No."  
c Tell me when I'm in range.  
p "In range now." "Optimum shot now." Or, I could say:  
o Count down the ranges.  
p "Twenty miles."  
e Twenty miles till you shoot? Is that what you're looking  
e for?  
p Until I say:  
o Stop ranges.  
e Okay, you'd like "twenty, ten, five, four, three, two, one?"  
e Something like that?  
p Yes, and I'd probably want to know target heading. If I'm  
p not looking inside, I want to be able to call that up. I  
p want to be able to say:  
o Target heading.  
p I can get the same info by looking inside; but maybe I don't  
p want to look inside, maybe I'm looking at my wingman. I  
p could also say:  
o Target altitude.  
p I want it to reply "Twenty thousand." Now that's useful  
p stuff; that's what the voice system is good for.  
e Keep you heads up.  
p That's what the voice is good for, is being able to get  
p information without having to look for it. Also, something  
p else I want to know is, what's my airplane doing? If I say:  
o Airspeed.  
p I want it to come back and say "500, 450" or whatever. If I  
p say:  
o Altitude.  
p I want to know that. Heading, all that stuff.  
e Yeah, it'd be pretty easy, I think, because we have voice  
e synthesizers now.  
p That'd be great now, that keeps you from looking in.

s 5.2.4  
e You each fire two missiles and immediately disengage, it  
e says here, because that's the tactic for MIG-39s, we'll say.  
e And, also, when you go against MIG-39s, you know you have to  
e cover your egress with chaff and flares, in case they shoot  
e something at you. How would you instruct your airplane to  
e do chaff and flares at this particular point?  
p I: I said:  
c Chaff.  
p or  
c Flares.  
p I would, again, expect to get either one chaff or one flare  
p out or a preprogrammed....  
e Well, if it knew what was needed for -39s, it could do that.  
p I probably want to have a difference between getting one  
p flare and one chaff out, rather than having it defeat  
p automatically. I probably would like it to defeat it  
p automatically, but I may want to do it differently. I mean,  
p maybe he's coming in to gun me, and I want to just put a  
p bunch of flares out in his face. I may say:  
o Flares, flares, flares, flares.  
p So maybe one will go down his intake.  
p Maybe I'll say:  
o Jettison the center line.  
p So we'll put the center line tank in his face.  
e That's one thing I hadn't thought about at all: jettison by  
e voice.  
p Maybe my goal is to be able to have an automatic command but  
p also a regular manual command at the same time.  
e How would you do that? How would you want it to distin-  
e guish between automatic chaff and flares versus manual?  
p I would say:  
c Chaff and flares.  
p for one chaff and one flare.  
p Chaff.  
p to put a chaff bundle out.  
e Then how would you say it for a preprogram?  
p It's just used different, a code word, a single word:  
c ECM.  
e "ECM against a MIG-39" or something like that? When you  
e said "Chaff and flares" for 5.2.4, the reply is:  
v Dispensed chaff and flares.  
e And it told you what it did, which, again, is probably more  
e feedback than you need, but that's the way we did it.

s 5.3.1  
e All four of the MIG-39's have been destroyed. And you also  
e know from a satellite link that the attack flight has wiped  
e out the airfield and RTB'ed. They're back drinking beer in  
e the bar.  
p Off the subject a little bit, but I...oh, that's right, you  
p said you can't do stick and throttle stuff. OK, never mind.

e Well, go ahead, anyway.  
 p Well, it might be nice to be able to say:  
 o Out of burner.  
 p Maybe if I'm in a left turn. To have the option to say:  
 o Out of burner.  
 o Idle.  
 p Especially if my hand is up here and I'm fighting some guy,  
 p since that sometimes is a player.  
 e I imagine the safety people would be reluctant to OK that.  
 p Probably you're right.  
 e That's something we've got on tape from a real pilot, so  
 e they may have to listen. After this air battle, your  
 e wingman is off in the weeds somewhere. You don't see him  
 e visually; and, for some reason, he's not displayed either.  
 e How would you find him or her?  
 p What's our call sign again? Do we have a call sign?  
 e What would you like?  
 c Two position.  
 e And it comes back:  
 v Wingman at nine o'clock, eight miles, line abreast.  
 p I don't need the "line abreast," but "nine o'clock, eight  
 p miles" is a good call. That's if we don't have the HSD. Or  
 p I want to call it up because I'm looking around by saying:  
 c Where is my wingman?  
 c Wingman position.  
 c Two position.  
 p Two's probably better, it's easier.  
 c Two position.  
 e Well, either one it should understand, because you may say  
 e it differently each time.  
 p That way I don't have to look at the horizontal indicator.

s 6.1.1  
 e After you rejoin with your wingman, you pause to assess  
 e your situation. What are you looking for, after this  
 e battle?  
 p No threats?  
 e You can see no threats on the HSD. You're headed home.  
 p Where's the strikers?  
 e They're home.  
 p Oh, they're home.  
 e They're drinking beer; they hit the field and went home.  
 c Pigeons.  
 e So you're looking for routing home, right? Anything else?  
 e System status? Find out if you took any hits? How many  
 e chaff and flares you have left? Or how many missiles you  
 e have left? Is any of that of interest to you now?  
 p Yeah, but I could probably look in.  
 p I might say:  
 o Did we take any hits?  
 p I mean, if you're really talking cosmic stuff:  
 c How are we doing?



p If there's anything wrong on the "How we doing" call, let me  
p know.  
e Would you expect that to come up automatically? If you took  
e a hit and you have a hole in your tail or your horizontal  
e stabilizer, something like that? Would you want a notice up  
e automatically?  
p I don't know; it depends on the situation. If I'm busy, I  
p wouldn't want that. If the airplane's still flying, I don't  
p know if there's a necessity for it or not. If it's on fire,  
p that'd be nice to know. Actually we have that already: a  
p fire light comes on.  
c How we doing?  
p For my own airplane.  
v Minimum RTB fuel; recover at alternate.  
e So that's our fuel display; we were talking about that  
e earlier. And you found out that you have min fuel. Can't  
e make it to home plate. No tankers available. But you can  
e recover at a number of alternates.  
p One thing I'd like to know, and I'd like it to be  
p automatic, is the fuel figures...not figures, but how's-it-  
p going fuel, here at bingo. It should say "Bingo." I'd want  
p to hear that.  
e Just like you do now; you get a bingo call from two or three  
e or four, or whoever.

s 6.1.3  
e How about this information? What are you going to do with  
e that? Can't make home plate; what are you going to do?  
p I'd want to know the threats. I'd say:  
c HSD and scope.  
p If we only had one scope. I'd want to know the weather at  
p the alternate.  
c HSD up.  
p Or just:  
c HSD.  
e OK, it shows three alternates that you can make, given your  
e fuel situation. And they're prioritized based on your  
e personal preferences. It takes into account such things as  
e battle damage, weather, safe passage routes, etc. Anything  
e else you'd want to know in that priority listing?  
p Weather, if it could display the field status. Since it's  
p wartime, whether or not there are any attackers coming. But  
p that would probably be on the HSD. If they're heading  
p towards that field, I'd probably want to avoid.... Other  
p than that, it looks good.

s 6.1.5  
e How would you select one of those, for the computer to plan  
e to profile?  
c Two.  
e OK. And since, again, you have options like that, would you  
e want your wingman to know where you're headed? Would you

e expect it to pass that to him automatically, as soon as you  
e made a selection, or do you want to pass it to him?  
p Yeah, I'd want to.  
e OK, how would you do that?  
p I'd tell him on the radio, "We're going to Ramstein." or  
p "We're going to Hahn."  
c We're going to Hahn.  
v Message sent.  
e OK, we're done.  
p It didn't take that long.  
e Anything you want to add, general or otherwise? Good, bad,  
e indifferent? I mean, you made a lot of good comments  
e throughout, but here at the end you're...  
p Nothing more than I already said. The voice system has a  
p lot of possibilities and looks really good. The only thing  
p that you want to watch out for is complexity. Just keep the  
p thing simple.  
e I agree.  
p Remember, your average pilot is not smart, really. I mean,  
p they think they are; but they're just average guys doing a  
p below average job. Just average guys out there, and there's  
p not anything special about them. And if you plan it for  
p about two levels below the average guy, then they'll all be  
p able to do it. And so, if you just keep it real simple,  
p it'll work out a lot better. You know, I think that's  
p better than most of the systems we've got there now.  
e Thank you for your help!

End of Scenario - Pilot 35

## APPENDIX K

### SUBJECT 44 - Biographical Data Form

Age (Years): 43  
Organization: Veda, Inc.  
Full time/Part time: Retired  
Occupation: Defense Analyst, Senior Staff Member  
Squadron position: (Not Applicable)  
Total flying hours: 4100  
Total jet hours: 4100  
Total years rated: 20

Specific Aircraft (type, hours): F-15, 650  
F-4, 600  
AT-38, 1100  
F/RF-101, 100  
(1650 hours unaccounted for)

SUBJECT 44 - TRANSCRIPT

s 1.2.2  
e We'll assume that your weapons onboard are just about  
e anything you need: long range air-to-air, short range air-  
e to-air, anti-radiations missiles, and gun.  
p Air-to-air, air-to-ground all at the same time?  
e Yeah, it's a dual-role futuristic fighter.  
p I like this airplane. But one of my concerns about talking  
p to my airplane is: What happens when I give a command and  
p block out an important radio call? It really concerns me.  
e Hopefully, the audio will be prioritized; but that can  
e happen now: You can transmit and block an incoming call.  
e Also be as candid as you want to about anything at all.  
e Some of the displays are really missing a lot of things, and  
e if you think you need more information, let us know. Okay,  
e you're lead of the escort flight here. You'll be  
e rendezvousing with the attack flight before the FEBA, go low  
e level over the FEBA and through a defended mountain valley.  
e The attack flight is going to knock out the airfield, you  
e hope, and you're going to go do some air-to-air combat. You  
e get information from satellite and data-link between  
e aircraft, both in your formation and from AWACS. I already  
e mentioned the weapons capabilities of this airplane. You've  
e got whatever you need. Unlimited, if you want; although if  
e you have concerns about shooting too many missiles or using  
e too much of your ECM expendables, then we need to hear that,  
e too...you know, if you don't want stuff popping off  
c automatically. And then the only other thing that I should  
e mention is that we don't want to discuss anything classified  
e at all. So, we don't want to get into precise tactics or  
e whatever you feel we shouldn't talk about. We'll stay on a  
e general level and just get your ideas about all this.  
p Are we coming out also, or are we just going in?  
e We're going to come out as well. The transition to air-to-  
e air may not seem realistic, but it's a BVR engagement. The  
e reason we do that is to pull out more vocabulary. So the  
e mission begins with your twoship of fighter aircraft  
e descending through 5000, 0.85 Mach, in the weather.  
p In the weather, had to be, huh?  
e That's right, makes it realistic. Your wingman is in trail,  
e maintaining his position via data-link. You as flight lead  
e are responsible for accomplishing the rendezvous. The other  
e airplanes are also aware of everyone's position via data-  
e link. On your horizontal situation display you have the  
e following: You just crossed navigation point two. You're  
e in blue, your wingman's in green there, number two. And  
e that's your course.  
p I came in here and turned that way, basically, huh?  
e Yeah, and believe it or not, that's proper formation for  
e this set of airplanes: five miles back. Again, maybe a bit  
e unrealistic, but if you play with us, or express your

e concerns about that.... So a few seconds after crossing  
e navigation point two, the following happens:  
v Rendezvous data.  
e Your airplane cues you with "Rendezvous data," meaning it  
e has information on the rendezvous; but if it spits it all  
e out at once, you may miss something; so it's prompting you.  
c Display.  
p If I was to grade conflict, right now I'm cruising along  
p behind the FEBA, and I'm going to rendezvous with some  
p friendlies. I'm expecting this to be on the radio.  
p Conflict's kind of low.  
e Okay, so you ask for the display, and you get the  
e following:  
v Sabre 41 at 14 miles, closing.  
e Sabre 41 is their call sign; your call sign is whatever you  
e want it to be.

s 1.3.2  
e So you get information on their position, and a few seconds  
e later you get the following:  
v Threat data.  
e Shows a "10" up there, meaning SA-10, and it's on course,  
e twelve o'clock, twenty miles. And, again, when it says  
e "Threat data" like that, you know from your training that it  
e has information for you; but if it spits it all out, you may  
e miss something. It's up to you.  
c Display.  
v Tracking J band.

s 1.4.1  
e So the system tells you that it's tracking you, J band.  
e What are your concerns and intentions at this point?  
p Launch envelope of the SAM and my flight path. Do I have to  
p go towards it? In other words, what's my projected flight  
p path?  
e Yeah, it is supposed to be right over the top.  
p Are there other threats in the area? Can I go around that  
p without getting in another threat?  
e There aren't any others that are showing. So are you  
e looking for possible rerouting there?  
p Yes.  
e How would you ask for that, if you could ask your machine to  
e show you?  
p Words that I'd like to use, huh?  
o Alternate routing.  
e Now, in this case, our scenario differs a little bit with  
e your intentions, only because we had to pick one thing or  
e another that we could do; we have limited capability. Here  
e we're going to ask you to consider some ECM possibilities.  
e So if you were to call up or do a verbal check of your ECM  
e equipment, how might you do that?  
c ECM status.

e You get the following: That's what your airplane looks  
e like; it shows the ECM in standby with 90 chaff, 50 flares.  
v Think we'll need this thing to dispense singles?  
e That's what it's programmed for now. Well, is that what  
e you'd like, or would you prefer something different?  
p I would prefer to have a program for each threat. To break  
p its lock, I need a certain program.  
e Do you need a status display like that, or do you want that  
e by exception?  
p I'd like something that says how many per second, some rate  
p at which it's going to do it.  
e Salvo.  
p Yeah, salvo, or three every five seconds or something that  
p says a rate for how long.

s 1.4.3  
e How's this change the situation? I mean, everything looks  
e like it might be working okay, or at least it's in standby.  
p He's tracking me now. I need to know when he can launch.  
e Okay, so you're looking for that threat envelope.  
p That's right.  
e Unfortunately, we don't have that for you; but how would  
e you ask for it?  
o Launch envelope.  
e Alright, that's your biggest concern at this point. We'll  
e get into some of that a little bit further downstream. But,  
e right now, given that your system appears to be okay, how  
e would you turn the stuff on to get it working for you? In  
e other words there's that SA-10 out there. And assuming you  
e want to jam it...maybe that's a bad assumption?  
p I'm not going to jam yet. If it can't launch at me, I'm not  
p going to jam; because if I do, I'm liable to highlight  
p myself to other systems that don't know where I'm at. So  
p I'm not going to jam yet. He can't shoot at me. If he  
p wants to watch me, that's okay.  
e Well, if you are in his threat envelope, how does that  
e change the situation?  
p I'm going to jam to try to prevent him from firing; and I  
p want to know if he fires.  
e You want a notification that you've been launched at?  
p Yeah, and where it is, and any assistance I can get in  
p visually acquiring the missile, but I'm in the weather.  
e Alright, given that you're in the threat envelope, you said  
e you'd be interested in jamming. How would you turn your  
e equipment on verbally for jamming?  
c Jam it.  
p That's what I'd say.  
e You'd expect it to know what "it" is?  
p Yeah.  
e Good, I would, too, because it told you it's out there.  
p For conflict, here, the backseater might think I'm telling  
p him to jam it.

e This is a single-seat jet; the backseater is a robot.  
p Seems about the same here. Workload is no problem  
p whatsoever on this one.  
e Okay, now when you say "Jam it," you're expecting it to do  
e what for you?  
p Put electrons on that tracking radar. Detect what frequency  
p and, if I have a choice, I want the guidance. If there's a  
p difference, what I really want is the guidance. Again, if  
p he can track me, I don't care. It's the fact that he can  
p get a missile to me. So if it's smart enough to know what  
p the tracking frequency is, it ought to be smart enough to  
p know what the guidance frequency is; and that's what I want.  
v ECM and chaff selected; threat no factor.  
e So what it did, based on its preprogrammed analysis of the  
e SA ten, it decided it needed both pod and chaff to defeat  
e the threat.  
p Okay.

s 1.5.2  
e So the ECM worked. The threat's no longer tracking your  
e flight as you approach rendezvous. And then a few seconds  
e later, you get the following:  
v Rendezvous data.  
c Display.  
e You're looking for more details, of course, so you get the  
e following: It shows Sabre 41 back there, at eight miles, in  
e position, for the preplanned rendezvous. Anything else  
e you'd like?  
p Closure. Am I pulling away from him? Are we synched?  
p Am I going to maintain that position?  
e Right, are you co-airspeed or co-groundspeer, really?  
p Yeah.  
e How would you like that shown? I mean, if he was pulling  
e away, would you like to see a little arrow showing that his  
e vector was moving away from you, or ahead of you, or....  
p Normally, if you're just reading radar displays, you see  
p some kind of a Vc, velocity of closure, plus or minus. If  
p he's gaining on me, it's plus.  
e But is actual or relative more beneficial to you?  
p Relative.  
e Okay.  
p We got the formation the way we like it. Is it going to  
p stay that way, or do I need to do something?  
e So instead of 480 knots, or in addition, you might like to  
e see a "+10" or a "-2" or something.

s 1.5.5  
e Moving on here, the rendezvous's complete, and your flight  
e is escorting the attackers toward the FEBA. As you approach  
e within twenty-five miles, your system does this:  
v Consent for fence check.  
e It's twenty-five miles to the FEBA. So the aircraft awaits

e your consent to automatically accomplish a fence check.  
e What are you thinking about at this point in the mission?  
p What I'm thinking about is: This is a reminder to me that  
p we're getting close; so I would be, one more time, checking  
p over the airplane to make sure that I'm going to take this  
p airplane over to the other side of that red line. I'm going  
p to tie stuff down in the cockpit if I have stuff out, put it  
p in pockets, and so forth, so I don't create a hazard. And  
p I'm doing not only status of the airplane but status of  
p munitions. One more time I'll make sure the formation is  
p established the way I want it. And get just as much SA,  
p situation awareness, as I can get. I want it armed up. I  
p want to make decisions on emitters. Do I want to emit or  
p not? Things that are going to be used to ID me, are they  
p on? Transponders, interrogators, are they on? You know,  
p recording devices that I may have on the airplane, I want to  
p make sure they're ready. You know, some guys use handheld  
p tape recorders, even, that they turn on at this point to  
p make sure they have voice recordings. We're getting video  
p tapes now....  
e You mean, to record the kill?  
p Well, just all the voice transmissions for debrief. They're  
p helpful for debriefing what went wrong. Well, if you lose a  
p guy it can help you track back to where he is, or where he  
p went down, or.... If you don't have time to lock in  
p coordinates, you just speak them. Let's see, that's the  
p aircraft, formation, cockpit condition, munitions, emitters,  
p arming....  
e Do you have an acronym for that?  
p RIP: Radar, make sure it's set up; IFF; ICS. ICS is our  
p internal combination set, IFF is transponders. It's been  
p too long since I had to do this. Tape, it's TRIT. Tape,  
p TACANS. It's air-to-air TACAN, and master arm gets in here  
p somewhere, but I don't know where. I don't remember.  
e The fence check's something you'd preprogram on the ground,  
e we're assuming, for your personal choices. Some guys do  
e different things, of course; although it seems like 99% are  
e doing it pretty much the same. Would it be preferable to  
e have a basic package to program?  
p And have the capability for guys to say "Also, I want this."  
p or "I don't want that."  
e Yeah, some default mode, where you can adjust it for your  
e own desires. To get back to the scenario, the airplane  
e prompted you by saying "Consent for fence check." So, how  
e would you tell it to go ahead and do that?  
c Complete.  
e And you get:  
v Fence check complete.

s 1.6.1

e So now you're initiating transition to low level, before you  
e go over the FEBA, of course. It's scheduled for 500 knots,



e 200 feet. Your aircraft has full TF capability, all you  
e have to do is select values, modes, and check equipment  
e status. So at this point in the mission, what are you  
e thinking about?  
p Routing, altitude, weather.  
e Still in the weather, sorry about that.  
p Threats.  
e Okay, they'd be on the scope there.  
o Continue to monitor the package and the wingman.  
e Okay.  
p Okay, I'm low level.  
e You're about to go low level, you're still descending.  
p Some aircraft are going to have some controllability things  
p I'm going to want to check before I go down low level and  
p accelerate to high speed. Fuel balance, and stuff like that  
p that I'm going to want to do so I don't load the airplane up  
p and have it flip. Once I get down there I'm going to do a  
p regular descent check to check the altimeter. If I have a  
p current altimeter setting or if I'm using my radar  
p altimeter...whatever I'm using to judge my height, so it's  
p perfectly calibrated and set. Depending on what altitude  
p I've been flying, for how long, I may be concerned about the  
p windows fogging up, when I descend.  
e Is that a problem with the F-15?  
p No, but in the F-4 it was. It doesn't have as good a  
p moisture separator or something.  
e Would you be interested in checking the TF equipment, make  
e sure it's okay? How would you do that?  
p What words would I use, huh?  
c Status.  
p I'd have to add something to that:  
c Status of TF.  
e Okay. Please evaluate that, and I'll show you what happens.  
e It's in the green. LPI is low probability of intercept,  
e meaning short bursts of radar instead of continuous. Set  
e clearance plane of 200. Low altitude warning of 100 feet.

s 1.6.3  
e And then you have the option of going manual or auto.  
p Okay.  
e How would you select one of those?  
c Auto.  
e And you get:  
v Auto.  
e That gives us some nice feedback there, and the low level  
e transition has been completed.

s 2.1.2  
e Okay, you're proceeding at 200 feet AGL, on course. The  
e current threats are on the HSD, horizontal situation  
e display. There are SAM-6's, AAA. None of them are tracking  
e you so far. No great concern, especially down at 200 feet;

e but a few seconds later, you get:  
v Threat data.  
e Pop-up threat.  
c Display.  
p As we're going through this, I get more thoughts. There's a  
p trade-off between.... I understand why you're doing this.  
p You're saying "I've got information if you want it, but I'm  
p not going to bombard you with it until you're ready for it."  
e Right.  
p The other side of that coin is there are two iterations I've  
p got to go through every time to get the information. If it's  
p displayed on a separate panel, and it just rings in my ear  
p one time, what it says is "I'm going to continue to display  
p this over here, and when you get time, look at it." See  
p what I mean? I don't have to ask it again. It'll be there  
p automatically. So I'm displaying it, and I'm telling you  
p it's there, all in one. But the way you're doing it here,  
p each time it says "I got it, I've got a secret, but I ain't  
p going to show it to you until you tell me to."  
e That's right. What's your preference?  
p If the number of displays is adequate, I'd rather have it  
p displayed and, when I get a chance, if I'm looking from one  
p side of the cockpit to the other, on the way through I can  
p glance at it and see it's out of range or "Holy hell!" or  
p whatever. Instead of having to remember to say:  
c Display.  
c I need it.  
p It would be better if it was there, and when I get an  
p opportunity, I can glance at it.  
e What if it knows it's a threat, by some of its features, its  
e aspect, but it doesn't know what it is. Do you want to be  
e notified at all until it is sure of what it is, or do you  
e want a preliminary notification?  
p I would assume that even though it doesn't know what it is,  
p it knows the azimuth. I'd like to know that. Especially if  
p it's close, so maybe I can look visually, and if nothing  
p else, I might be able to pick up a missile even if it has an  
p ambiguity it doesn't ever pick up. Maybe I can find it. And  
p maneuver against it.  
e Yeah, good.  
p You know, if it's an unknown, it should come up yellow with  
p as much information as it has: it's on this azimuth, or  
p whatever. And if it's an unknown to me, that means, also,  
p if I can, I'm going to steer away from it. If I have a  
p choice, I'm going to say:  
o Alternate routing.  
e Good, that's what we need to hear. You asked for more  
e information, and here's what you get:  
v Helicopter eighteen miles, twelve o'clock low, closing.  
o Ram him!

AD-A192 972 A COCKPIT NATURAL LANGUAGE STUDY - SELECTED TRANSCRIPTS 474

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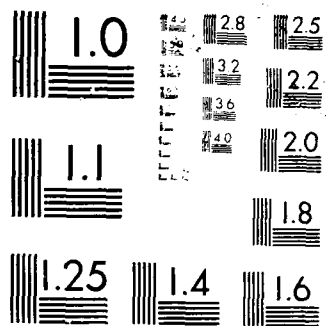
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s 2.1.4  
e In your intel briefing that you got before takeoff, you  
e learned that the Soviets have a new helicopter; it's their  
e version of Blue Thunder; it has air-to-air missiles and all  
e sorts of things....  
p And it's low, of course, but....  
e It's maneuverable and appears to be coming at you, how does  
e that change your situation?  
o ID.  
p I want to know if it's hostile or friendly.  
e Okay, it's hostile, it came up red.  
p That's already there, okay.  
e Right, that's the color coding we're using is red hostile,  
e green friendly, and yellow unknown.  
p OK, I want to know if it's one of those you just described.  
p I want to know if it's armed, if that's available, and with  
p what, and where are the envelopes? When can it fire at me?  
o Notify me right away, if it does fire.  
e No delay there. Maybe you can't discern that sort of  
e information; you can't tell what it's carrying, but it may  
e be that bad helicopter you heard about in the intel brief.  
c Arm them up.  
e What are your intentions there, when you say that?  
p Going to fire. In my mind, the conflict is starting to pick  
p up now, even with data-link systems. There's probably going  
p to be some kind of voice confirmation going on here where  
p we're starting to talk about...especially it's going to be  
p real unlikely that there's one chopper, so we are going to  
p be.... And I realize, we're going to be data-linking to  
p designate this target. To me, in my mind, conflict is  
p starting to pick up, especially if there's a pop-up.  
e You're not going to want to wait. So, what you get is:  
v Master arm on.  
e Shows you a long range air-to-air missile ready to go and  
e another one in standby.

s 2.1.6  
e Okay, what's the next thing you're looking for?  
p Is firing.  
e Okay, so you're looking for....  
c Am I in range?  
e Do you expect that automatically, a shoot cue?  
p That's right, I'd like to know when it comes up, like here,  
p not only to know that the missile's ready to fire, but am I  
p in range to fire it? Has it got everything it needs to  
p leave the rail? Actually, I'd like to see a choice. If I  
p have more than one weapon onboard, I'd like to see a choice.  
o Which weapons could I fire?  
e Then, you'd decide the best one?  
p Yeah.  
p If I've got heaters and radar missiles, if I've got active  
p and semi-active, I'd like it to say which ones I'm in range

p with. And then make my choice. What I feel is the best.  
e Okay, that's really good. There may not always be a single  
e choice of weapons, that's a good point.  
p Yeah, and I might be the only guy who knows that we're  
p almost fresh out of this kind, back at the base. We don't  
p have any AIM-9L's left, or whatever. We don't want to use  
p those unless we have to.  
e First time we've heard that, that's really good. So you're  
e looking for a bunch of different things.  
p Especially what I'm looking for is: Can I fire right now?  
e Okay, how would you ask for that?  
p "I'm trying to think. I don't just want to say "Am I within  
p range?" because then it'll give me maximum range. And that  
p may not be a good idea.  
e Okay, you're looking for, maybe, a couple of different  
e things: Max range, optimum...  
p Yeah, that's right, give me not only maximum range, but  
p minimum range and probably one other in the middle there.  
e Well, that's really better on a display than voice. It's in  
e the HUD now, right?  
p Yeah.  
e How would you ask for that display?  
p I guess I'll just say:  
c Weapons launch criteria.  
p I'm not very satisfied with that.  
e Is there something you would say to a backseater, maybe more  
e of a jargon?  
p See, if I say "What's our range?" he's going to say "Eight  
p miles." That's great, but that doesn't tell me a thing.  
p What I'm really asking is...what the heck, we're talking  
p artificial intelligence...I'm asking:  
c When do I shoot?  
e Okay, and you'd expect those things we just talked about.  
p Yep. There's another thing we haven't talked about, too:  
p rules of engagement. I have to go through that hoop before  
p I can shoot him.  
e I guess, when we get into details on that, ROE would be  
e locked into the smart computer. What you get is:  
v Radar locked, in range, optimum five seconds.  
e So it gives you an aural cue, which isn't exactly what you  
e asked for. So you count down, in your mind, four, three,  
e two, one and pull the trigger. That'll always be manual.  
e The helicopter goes down in flames.  
p I want to strafe the chute to make sure there are no  
p survivors.  
e Nice guy!

#### s 2.2.2

e The helicopter goes down in flames. You proceed on course  
e through the mountain valley approaching the lake. Your  
e formation's still intact, but now the bad guys know you're  
e coming. They sent one of their choppers after you, and you

e blew it away. So the element of surprise is probably gone,  
e which may or may not be important at this stage. A few  
e seconds later, you get the following:  
v Threat data.  
c Display.  
p I'm not sure this is adequate to communicate what I mean,  
p but I'm starting to home in on the fact that I had to tell  
p it to display it.  
e You want it automatically instead of having to ask for it.  
p Takes two steps.  
e That's real important to hear. Alright, so you asked for  
e details, and you get:  
v ECM ineffective, reroute available.

s 2.2.4  
e So, it tried to jam this SAM-18 automatically, rather than  
e being told to, and determined that it couldn't. And now it  
e says that a reroute's available.  
c Display.  
e What are you looking for? What would you like to see?  
p Our routing around the threat. It has to be figured and  
p passed to these guys, and has to be within their range. I  
p assume that my range is bigger than theirs; that's usually  
p the case because I'm cleaner, usually.  
e So you want a new route that's going to take into account  
e the whole formation.  
p Right.  
e Anything else?  
p The routing should avoid the threat and be cooler. Since  
p we're talking about a new routing, we need to know about the  
p terrain again and the weather. This new routing is  
p predicated on these threats. And let's assume the new  
p routing's over here. What's here? Are there more threats?  
p I mean, is this a short term fix? Am I still going to be  
p flying some of this envelope, even with the rerouting?  
e Good questions. Suppose your rerouting is done on your  
e vulnerable time up to your IP; is that far enough out for  
e you for a reroute analysis?  
p Yeah, and I don't think you want to reroute after the IP.  
e Right.  
p The reroute may not even be that far out; it may just be a  
p temporary jink or something. It just depends. I'm hoping  
p that the system's smart enough to take all that into  
p account. What did I say for the command?  
e You said "Display."  
p "Display," okay.  
e And you get: a reroute to the right there with an  
e acceleration to 510 to meet your TOT.

s 2.2.6  
e And as you expressed earlier, you want the other guys to  
e know about it; how would you do all that by voice?

p How would I then say that I'm going to go this way, huh?  
e Right, or maybe you don't want to accelerate, or any number  
e of things.  
o Execute.  
e And then you talked about passing it to the rest of the  
e flight because you'd like them to know, of course.  
p So I also need a word for saying to tell.... In other words,  
p if I say "execute," it's going to do it to me but not them?  
e Yes, they're looking at something else, or doing something  
e else. How would you pass that to them.  
p Short way of saying it, I'll say:  
c Put it on the net.  
v Message sent.  
e It comes back and says "Message sent," which means that the  
e message was sent and received. They acknowledged it.  
p Okay.

s 3.1.2

e You're proceeding on the rerouted segment of the low level  
e approach at 200 AGL still, when you get a JTIDS update about  
e a new threat. You requested additional threat information  
e already, and the horizontal situation display automatically  
e changed scale to show the threat aircraft like that. It  
e shows them in yellow as unidentified, still. And the other  
e thing I should mention is the airplane is still set up for  
e the low altitude threats. How's this change the situation  
e for you?  
p Okay, I'm going to continue on ID, since they're unknown. I  
p want to know information about: Are they a threat to me?  
p What's their closure? I kind of have a hint on which  
p direction they're heading, but I want to know information  
p about their projected flight path relative to mine. Can I  
p avoid them? What I really mean is, are they a threat to my  
p package that I'm escorting. Can we avoid them if we push it  
p up? I need information to determine whether or not they're  
p a threat to the package.  
e Okay, how would you ask for that?  
o Should I engage?  
e Okay.  
p No, I'll back that off. I would ask:  
o Should I commit?  
e What we're going to do here, though, is a little bit  
e different, and it's a little bit far out, since they're way  
e out at 200 miles. We're going to ask you to remode your  
a cockpit for a possible air-to-air battle.  
p Oh, OK. So how do I tell it to reconfigure for air-to-air?  
c Go missiles.  
p That's not right. I have air-to-surface missiles. How  
p would I say that? What word would I say?  
e I guess we're thinking that, as you fly along low level,  
e most of your sensors are pointed down in front of you; but,  
e you were thinking of pointing them up at this possible



e threat to get more information, to do the ID that you're  
e interested in. So instead of looking down....  
p Well, maybe it's an unfair question; but, how did I get the  
p sensors where they are? By going TF earlier, I assume?  
e I guess, sure.  
p I can say things like:  
c Go air-to-air.  
p Or I can say:  
c Search high.  
p That one's a little nebulous. Do I want to search high? If  
p I search high, how about the other airplanes that are low?  
e Search high and low? Instead of being focused down here, do  
e both. I don't want to put words in your....  
p You know, I understand the sensors are doing their thing for  
p terrain following, so I need them to stay down there. If I  
p tell it things like "search high," does that mean I'm going  
p to climb because I don't have TF anymore? I don't know what  
p the capability of my system is, here. I'd like to be able  
p to do both. And I'd also like, while we're doing this, to  
p give some search responsibilities to my wingman.  
e Okay.  
p Right, but the reason for that is the F-15 radar can only  
p paint so much, I can only shine the flashlight in so much  
p airspace, so we divide it up. "Search" I like; but I have  
p to rate it poor for usefulness. The reason is if I'm given  
p a threat out there, and I can assume that the wingman also  
p has that threat, if he's not searching out there, he's dumb.  
p So it probably should happen, automatically. And most guys  
p are going to say, "Hey, somebody's out there. Take a look."  
e So when you do a search, you get:  
v Configured air-to-air.  
e Get some feedback. It tells you it's looking out there.  
e It's configured air-to-air.

s 3.1.4

e What's the next thing that you'd be worried about?  
p Not a whole lot right now; if they're at 200 miles, I'm  
p happy.  
e Okay, you just want to keep an eye on them, and press on.  
e Well, believe it or not, we're going to ask you to get a  
e missile ready, just in case. Even though they're way, way  
e out there.  
p But I'd be happier if I had a missile ready.  
e Okay.  
p I'm gonna use the same thing, then. I'm in the air-to-air  
p mode, so all I have to do is:  
c Arm them up.  
v Master arm on.  
p Now then, for the rating. I'll mark it down because we're  
p doing it at two hundred miles.

s 3.1.6 and 3.2.1  
e This airplane has an infrared search and track sensor. And  
e it may be able to help you get an ID on these guys. But you  
e have to specifically call it up.  
p I would like to have an integrated system that uses all  
p sensors onboard for ID: infrared, RF, radar, signal  
p analysis. So I'd just like to say:  
c ID.  
e There's the IR. Shows the bogeys over there at 20 degrees  
e left. You're the blue triangle at the bottom there.  
p Range two hundred.  
e And then you get:  
v Hostile.

s 3.2.3  
e So it tracks them for awhile, determines they're hostile,  
e and paints them red. How does that change the situation, or  
e does it?  
p I don't think so, not at this range.  
e Okay.  
p The primary concern is, are they a threat to my package?  
p And second is, if there's any chance of their being a threat  
p to my package, what's their relation to my firing range?  
p What missile should I shoot, and when should I shoot?  
e Okay, we're going to get to some of those; but before we  
e do, we're going to explore some more issues for this sensor.  
e If this were just a single dot, but it was suspected that it  
e was a formation of some sort, and you had the ability to  
e focus the sensor on that portion of the sky to break out the  
e possible formation, how might you do that?  
p Just say:  
c Formation.  
p In other words I could use that sensor to tell what  
p formation they're in.  
e This has been tough, since nobody has this yet, exactly.  
e Although I guess they used to. One of the guys was saying  
e the A-7 or F-100 used to have an infrared sensor.  
p The F-101, too.  
e So, you get the following: And it shows zoom mode, and puts  
e you in the corner. Shows them about same place. Suppose  
e you could design an integrated sensor display of that sort.  
e What would you like to see?  
p You mean, what would I like it to tell me?  
e Well, yes, or see, either one? What would it look like, in  
e your mind?  
p First, I'd like not to see me be in a corner. I'd like to  
p see me here (center of bottom edge), so it's always relative  
p to my airplane. If it's a 360 degree sensor, then I'd like  
p to be here (center of display). If the information's  
p available, I want not only the blobs, but a point on them,  
p so I can tell at a glance which way they're headed.  
e Good.

p I also personally like different length arrows, depending on  
p their speed. Basically, three categories: the average one,  
p or really slow, or something to key me that he's really a  
p fast mover. Formation, I'd like to see, and ID by color.

s 3.2.5

e One of the things you mentioned, there, just now, for 3.2.5  
e was an idea of where they're headed and what sort of speed  
e they've got. And we'll say that this sensor, based on the  
e past few seconds, can give you track analysis on these guys.  
e How would you ask for that? I get a feeling you'd like it  
e automatically. Is that the idea?

p Yes.

e How would you ask for it, if it wasn't automatic?

p I'm asking for tracks, for where they're going? And how  
p fast? Can't think of anything short...

c Heading.

p and

c Speed.

p I'm not very pleased with that.

e That's why we're doing this with a lot of different pilots.

p There's got to be something better to say. What's it going  
p to say?

e The phrase that we've used is "track analysis," but that's  
e probably too long also. Would you rather say "Track?"

c Track.

p And I'm also tempted to say:

o Are they a threat?

o Is it a threat?

p That's what I really am concerned about; but then the  
p problem with that is that it may say "Yes" or "No." Which  
p means, "It's not now, but if he moves another three feet he  
p will be." Then, I'd like to know that now. Look at where  
p I'm at. It's still a long ways out.

e If you had a continuous display on them, then you'd know  
e whether they're closing faster. So what we give you is:

v In range for air-to-air radar.

e So it shows them, and, again, you're here. So they're  
e coming at you; and we'll just imagine that each hash mark is  
e 100 knots. So that's about 500 knots closure.

s 3.2.7

e And the system also prompted you that they're in range for  
e air-to-air radar. Is that useful to you?

p That is. Two hundred miles away, still right?

e Roughly. It'd be continuous updates, so they probably will  
e be a little closer now.

p At 200 miles, especially with my missile armed up, I'm very  
p comfortable. I'm thinking "Since they're within range for  
p the radar, lock the radar on." I think I really need to do  
p that. But, I know about where they are; and if I can watch  
p them without emitting.... I know where they are, and maybe

p they don't know where I am. I'd be interested right now in  
p any radar warning receiver information. Do they know where  
p I am? Are they looking at me?  
e How would you ask for that? Just the way you did? Is that  
e how you'd ask the backseater?  
p I'm tempted to use an old term, but it's going to be  
p outdated.  
e No, not necessarily.  
p I'd say:  
o RHAW.  
p Radar homing and warning receiver.  
e What are you expecting back from something like that?  
p Who's painting me, on what frequency, at what location, and  
p what range, if I can get it.  
e Okay. For the scenario, we ask you to switch over to your  
e air-to-air radar, since it said it was in range. Which  
e really goes against what you were saying about wanting to  
e stay passive.  
p Okay, I'd say:  
c Track.  
e OK, and you get this display. And it shows them as being  
e MIG-39's now. Of course, you know from your intelligence  
e briefings that these MIG-39's are a fairly formidable air-  
e to-air threat.

s 3.2.9  
e The radar confirms them to be MIG-39's, and your onboard air  
e battle management system has computed optimal intercept  
e profiles for these guys. These intercept options are  
e available upon request. Now, here, we don't have a cue  
e saying "Intercept options" or something like that.  
p Am I to assume at this point that they're considered a  
p threat to my package?  
e Yes. I mean, you really wouldn't know for sure at this  
e point, but it looks like they're probably headed at you.  
p So intercept profiles are available. How can I get away  
p from saying "display?" I've said that so many times. It  
p didn't cue me, so I can't say "display" because it won't  
p know what the....  
e Not this time. We'd like to pull in some different words,  
e also.  
c Commit.  
e Okay, that was for 3.2.9. So here we're back to the round  
e scope. Shows them at 125, and shows you two options:  
e Intercept option number one has a shorter time to engage,  
e that's why it's number one, and a PK of 0.5. Number two  
e takes longer, is more conservative, but has a PK of 0.98.  
p Okay.  
e Now, ideally, that would be shown on the display, so you  
e wouldn't have to read it in the handout. Otherwise, you  
e wouldn't know. Well, let's say it's displayed, just for the  
e sake of argument, so that you know that. So what's that do

e for you?  
p I need more information.  
e Okay, such as?  
p Where's our route going here? Where are the guys I'm  
p escorting going? If they're going off this way, then I want  
p to get over this way, as far as I can. I want to intercept  
p these guys as far away from the package as I can without  
p getting drug too far off course. See, if the flight path's  
p right up through here, then I probably want to go over this  
p way and have the intercept take place away from the package.  
e It looks like from the picture that these guys are here and  
e the target's over there.  
p So, no matter. Any other surface threats or air-to-air  
p threats?  
e Doesn't look like it. Nothing showing on the scope.  
p So, it would automatically show? I can assume that the PK's  
p are listed here for the missiles I selected?  
e Do you want different PK's? That brings up a good point.  
e Would you want to see the different PK's for each type of  
e missile; that is would you want to know your PK for the long  
e AIM versus the short AIM, or heater versus radar?  
p Yep.  
e That'd be quite a lot of information there.  
p It is.  
e Maybe it couldn't compute the differences this far out; but  
e tighter in, maybe, it'll say you got the best shot with  
e this missile.  
p Theoretically, I think that what I'd like is for it, when I  
p say "arm them up," that it chooses what is supposed to be  
p the best missile, and displays the corresponding PK, only.  
p Now if I want a different missile, then I need to be able to  
p to override that, and have it display that PK.  
e Yeah, you'd always be in control. You shouldn't have to  
e argue with it. It shouldn't come back and say "No-no-no,  
e you really want these long AIM's."  
p I'd figure it probably didn't hear me. "What I really meant  
p was...."

s 3.2.11  
e Alright, so, here we have these two options, and what we're  
e looking for, specifically, in 3.2.11 is which one would you  
e pick? You've already described your concerns, so....  
p Everything being equal, I want the intercept to happen  
p quickly.  
e Okay.  
p Wait a minute, though, the PK is different, isn't it?  
e Yeah, option one is 0.5.  
c Take one.  
e Okay, that's for 3.2.11: the ability to select one of those  
e by voice. And, once again, we had a fifty-fifty chance,  
e like the TF auto and manual, but we picked number two.

s 3.2.13  
e Sorry about that; that's the one we follow for the scenario.  
p I'd like to have it:  
c Put on the net.  
e And it responds:  
v Message sent.

s 3.2.15  
e Okay, you're committed now against the air-to-air threat,  
e even though you really don't feel you are. We're going to  
e force you into something.  
p Okay.  
e But, going back to what you're really concerned about: the  
e package and how they're doing.  
p That's right.  
e You've split off from them and you're going after the MIGs;  
e but you still want information on the package. How would  
e you ask for that?  
c Friendlies.  
e Okay.  
p Probably going to be some conflict there, in that I may get  
p friendlies up the ying-yang, but I don't care. I figure I'll  
p be able to sort out which ones I'm looking for; so it can  
p give me all of them.  
e For a display like this, you should always have your  
e package, where they are, and the target. So you can keep  
e that whole picture in mind and figure out your intercept.  
p That's right.  
e But we purposely leave out info, so you get to ask for it.  
e Instead of the display this time, we're just going to get a  
e voice message:  
v IP inbound.  
e Tells you they're IP inbound.  
p Okay.  
e So maybe there weren't any other friendlies in the area or  
e maybe it knew what you were really interested in.

s 3.3.1  
e It confirms that strike lead is at IP inbound, and you're  
e assured now that your responsibility is to attack the air  
e threat and to allow the attack flight to initiate their  
e tactics to knock out the airfield. Along with this flight  
e path information, the machine has the ability to give you  
e command steering or a GCI-type vector. Would that be useful  
e to you? Would you want that automatically? Would you want  
e to ask for it?  
p It's not bad to have.  
e Okay. How'd you ask for it, given that it's not automatic?  
c Bogey dope.  
e We've heard that one a lot.  
p I'm going to have to say "bogey dope" to somebody, just like  
p in current airplanes. Might as well be my onboard computer.

e And you're looking for detailed information on those guys?  
e Or just a vector into them, or...?  
p I'm just looking for a general place to point. But, I feel  
p like they're still a hundred-and-some miles out; I'm not  
p panicked. As we get closer in, I'm going to start worrying  
p more about the formation: if they're maneuvering; what their  
p capability is against me; and how I should target.  
e We'll do all that. But first:  
v Vector 060.  
e Gives you a quick vector, snap vector.

s 3.3.3

e Let's see, following the scenario, you're halfway through  
e that stern conversion. Again, we don't always update the  
e display, but we'll assume that it's continuous. The enemy  
e formation is not maneuvering, and it looks as though you  
e haven't been detected yet. It says here, you're ready to  
e split your flight and assign targets. Is that a true  
e statement? Are you about ready, as they're getting close?  
p Yes.  
e How would you get your wingman to the position that you  
e want, or would you assume that he'd go there?  
p If he's briefed right, well, all I need to tell him is which  
p one of those guys are his. Then I can assume that he's  
p smart enough to keep me in sight while he targets the right  
p guys. And the word we used in the F-15 an awful lot is:  
o Sort.  
e To get the targets assignment?  
p It's targeting.  
e Okay, we're going to do that in a second. Before that,  
e though, we'll make the assumption that the wingman is a bit  
e of a ding-bat and is still back there in trail.  
p Okay, we're still in the weather, I assume.  
e Does that affect one way or the other?  
p Yeah, if he's in the weather, I'm still going to try to keep  
p us together. So I'm going to assume that he is going to  
p stay in trail and just keep tracking me with his sensors.  
p And have a way of joining up with me.  
e Okay.  
p If he's not in the weather, I'm going to have him join up in  
p a more defensive formation.  
e Okay, how would you have him do that, if he's not in the  
e weather? How would you tell him to do that?  
c Tactical.  
e Okay, and right now you'd do that over the radio?  
p Yeah, or rock the wings or something. By the way, I would  
p have done that as soon as we got out of the weather,  
p whenever that was.  
e Okay, to keep this realistic, assume you just popped out of  
e the weather. And the reply, since we're not doing things by  
e radio, it's all data-linked:  
v Message sent.

s 4.1.2  
e So, getting in a little closer here, one of the things you  
e talked about was sorting; the machine has the ability to  
e give some suggestions, so it prompts you:  
v Target assignment ready.  
c Display.  
e Okay, so it circles your guys in blue and numbers them "1,"  
e and circles the wingman's guys in white.

s 4.1.4  
e Now when the machine does that, you can accept or refuse  
e that targeting. Which would you do, and why? Does that  
e seem reasonable, or is that way out?  
p Depends on where the wingman is.  
e Say he's over there, or something.  
p Yeah, that's reasonable.  
e On that scale, it's hard to tell.  
p I'm going to do side-side if I can. I'm going to take the  
p guys on my side, he's going to take the guys on his side, if  
p that's the way we're approaching. If I can't do that, I'm  
p going to take the leaders, and he's going to take the  
p trailers. I'm going to take the closest, and he's going to  
p take the furthest away. Can't do that, I'm going to take  
p the low guys, he's going to take the high guys, or some  
p combination.  
e Given that that's his position, off to your left, how would  
e you accept that?  
p What do I say to...?  
e Yeah, what would you tell your machine, to go ahead and plug  
e that in, and plan for it, that sort of thing.  
c Target.  
p I've already said "sort." What I'm really saying is:  
c Sort it.  
p It's awful close. I'm not doing a very....  
e Well, hopefully, technology is good enough to figure out  
e your intent. That's good, that's your way of accepting it.  
e Okay, and we'll assume that when you do that, that the  
e wingman gets the same info.  
v Message sent.  
e And so that's the reply.

s 5.1.2 and 5.1.4  
e As your wingman moves out to line abreast, the enemy begins  
e to maneuver and appears to merge.  
v Targets cross.  
e As you close within thirty-five miles, that's what you get.  
e Targets numbered "1", the blue guys, appear to be converging  
e on your flight; while the guys circled in white, numbered  
e "2," look like they're attempting to separate toward the  
e airfield and your package. What are you thinking about now?  
e How's that change things?  
p I'm thinking about: We got to make damn sure that we search



p for higher priority targets, right there, if they're going  
p towards the package. But they're already targeted, so I'm  
p probably going to.... We're visual now, right?  
e Yep.  
p I'm going to tell wingman to:  
o Engage.  
e Okay.  
p That's his targets.  
e And you're expecting him to accelerate and go after those  
e guys, and do whatever it takes?  
p Right.  
e Okay, and what are you going to do?  
p I'm going to keep track of these guys, and I'm going to keep  
p my wingman in sight. When they become a threat, I'm going  
p to fire at them.  
e Okay, for the purposes of our scenario and to get some  
e different words, we're going to ask you to swap assignments  
e so that the wingman gets these guys and.... Again, that may  
e not be realistic, but then we're getting some more words  
e from you by doing that.  
c Switch.  
e Okay, that's easy. So you said "Switch," and it did it.  
e And, again, would you want the wingman to get that auto-  
e matically, or would you want to pass it to him specifically?  
p Automatic.  
v Message sent.  
e So that was 5.1.4, as well as 5.1.2. From now on, anything  
e that happens gets sent automatically to the wingman.  
p I like that.  
e Well before that, how would you command that option?  
p You mean, to get it in the auto-data-send mode?  
e Yeah, get it in, take it out, that sort of thing. This is  
e just an aside, not part of the scenario.  
p Let me think. That's good. And I'm saying:  
o Autonet.  
e From this point on, everything goes to the rest of the  
e formation.  
p Okay.

s 5.2.2  
e After that target swap:  
v Targets in range in ten miles.  
e What are you thinking about now, with that information?  
c Arm them up.  
e And you'd be looking for what?  
p The best way and the best weapon. And, also, it would be  
p nice to have that go to wingman, which, I guess it already  
p did, since "autonet." If nothing else, that's a reminder to  
p him that I armed them up.  
v Master arm on, radar locked, in range, optimum 5 seconds.  
e Okay, so it's giving you a shoot cue. What are you thinking  
e about now?

p Normally, I arm them up and leave it at that. I got a hot  
p button there, but that's what I need.  
e That's the way we've done it here, too; they're ready to  
e fire. So it said "optimum five seconds." You count down:  
e four, three, two, one, squeeze. You and your wingman fire  
e two missiles each and immediately disengage. And also, you  
e know from your MIG-39 tactics, you're supposed to cover your  
e egress with chaff and flares. How would you do that  
e verbally?  
p There's a standard word for that.  
e For chaff and flares? You mean, like "expendables" or  
e "dispense?"  
p Something like "sparkle."  
e Is that something you'd tell a backseater?  
p The flight. The reason we did it was because we left chaff  
p and stuff set, then we do a hard maneuver to get away from  
p it. So, hopefully, the radar would at least track us  
p for.... Well, when it came back, the chaff would still be  
p there, so they'd be easier to find again. But we had this  
p wingman sitting out there one to one-and-a-half miles away.  
p So how do we tell him? We can't start maneuvering hard and  
p then tell him. So we say:  
c Sparkle.  
p And then give him a lot of sparkle, and then break. He sees  
p me breaking all to hell. Now if he does it a few times, he  
p figures it out, that after I say "sparkle" that I'm really  
p going to start maneuvering. He'd better get ready, better  
p keep his eyes on me.  
e OK, you start your heavy maneuvering, and machine tells you:  
v Dispensed chaff and flares.  
e Just to confirm.  
p Really a busy time.

s 6.1.1 and 5.3.1  
e Okay, you shot your missiles, and the four MIG-39's are  
e destroyed. You also learn during your disengage maneuver  
e that the attack flight has wiped out the airfield and is  
e back in the bar, drinking beer. So, how's that change the  
e situation? Here you are, you've gotten away from the bad  
e guys, and it doesn't look like there are any other threats.  
c Status check.  
p I need to know gas, battle damage, know how many missiles we  
p got onboard, what observed results we have or what intel  
p we've collected. Let's see, status includes: fuel, general  
p aircraft status, how to get out of here....  
e Relax and compare notes, and then press. How would you say  
e that, to get the checks? I think you used a phrase in  
e there, but....  
c Status.  
p But I already used that word. I would say:  
c Fence out.  
e Okay, you want to cover all those things you just listed.

e Okay, we'll skip a little bit. "Fence out" is for 6.1.1.  
p Okay, I have to do that one way or another, either tell the  
p machine or tell him.  
e When you do that, you're assuming that your wingman is with  
e you?  
p That's correct.  
e We're going to make the assumption here that for some reason  
e he's not. When you shot these guys and maneuvered, and  
e since the targets split, you might have...  
p Got separated, huh?  
e And lost visual of each other. How would you get joined  
e back up?  
p Now, what would I say?  
c Join it up.  
e Okay, right now, that'd be a radio call, right?  
p Yep.  
e "Join it up," for 5.3.1.  
v Wingman at nine o'clock, eight miles, line abreast.  
e And then, of course, the status check that you asked for:  
v Minimum RTB fuel; recover at alternate.

s 6.1.3  
e But it says here that your present fuel situation is  
e insufficient to recover at home plate, and there are no  
e tankers available. There are a number of alternates, of  
e course, that you know about. So what does this do for you,  
e being almost out of gas.  
p So where are the alternates? What's the closest one?  
p What's their status? What's their weather?  
e Okay. How would you ask for all that? Just like that?  
c Alternates.  
e Shows you some alternates, with some numbers on, and the  
e numbers are based on your personal preference for  
e priorities. And what would that be based on?  
p Well, let's see...range....  
e They're all within range, or they wouldn't be displayed  
p ....status of the airfield, with the bombs dropping there;  
p weather; ability to recover, service, reload, and launch my  
p airplane.  
e Okay, so you want them numbered in that sort of priority.

s 6.1.5  
e So, for 6.1.5, how would you select one of those, given that  
e they're ordered based on your personal preference?  
p Say a number.  
e Okay, which one?  
c Three.  
e Okay, you want to go to three. And when say that, what  
e would you expect to happen? We'll consider that you're  
e already in auto transmit mode, or the autonet mode that you  
e talked about earlier.  
p The wingy.

e You want wingy to know?  
p Yes.  
e Do you want Ramstein to know you're coming?  
p Sure. Okay, for that matter in wartime I want the command  
p and control agencies between me and them to know.  
e Okay.  
v Message sent.  
e And it tells you "Message sent," meaning that all those  
e people got it.  
p Okay.

e Also, any general comments you have. Are we missing the  
e boat with this? Are we getting some realistic stuff?  
e General comments, opinions?  
p Nothing, pretty good. I know this isn't realistic at times  
p and that's not what I might do, but that doesn't really  
p matter for talking about the system. I mean, what you're  
p interested in is: do you have the capability and will this  
p system work to do this; and if you did, would that be useful  
p or would it be in conflict with what I'm already doing?  
p Would it be fast enough? Would it be in conflict with what  
p I'm doing, or is it additional or less workload? It  
p concerns me that, since alot of the vocabulary will be words  
p that just spring to my lips, that I might be flying along  
p and not wish to command this thing to do anything, but one  
p of those words comes out of my mouth.  
e Right now, the systems are push-to-talk. They're not open  
e mic. We'd like to see them go open mic, like you'd have  
e with a backseater. But, then it has to be smarter, to know  
e when it's being talked to, and when it's not. There are  
e alot of issues with this technology that must be addressed  
e before we see it operational.  
p Neat idea though, be glad when you get there.  
e Probably take a few iterations to get there.  
p That really is, I think, the world the fighter pilot lives  
p in right now. We discovered in the recent past that we have  
p this monumental mountain of information for him. And then  
p we tend to sit on the ground, repeating all these numbers  
p and everything, and he's up there going (eyeballs rolling).  
p You can't park a fighter up there to read the small print.  
p I think we tend to dump data on him rather than information.  
p We're finally turning the corner, now, in the operational  
p field with our radar software. Before, it was guys  
p streaking toward each other at 11,000 miles an hour, and  
p we get all this print around the radar scope. Do they  
p really think we're reading that?  
e They do.  
p Well, now, we're starting to get symbols. Like my radar  
p symbology has pointers instead of rectangles. But what they  
p did was print the aspect up at the top of the scope! So we  
p had to either measure the angle or look up there to read it.  
p And we had to look up again to see how fast he was going.

p You know, so just now we're getting to where we're using  
p symbology to say all that. Now the thing points over this  
p way, and it's so long. Hopefully, in the future, I think  
p they're still going to have it be so long for a fast mover,  
p and a wee little one for a slow mover, and, then, the one  
p we're used to seeing all the time for everybody else.  
e Thank you for your time and all your comments!

End of Transcript - Subject 44

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